Railway AND Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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A Practical Journal of Motive Power, Rolling Stock and Appliances

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On the Arica-La Paz Railway in Bolivia

The construction of the numerous railways crossing the Rocky Mountains in North America has generally been looked upon as the most difficult engineering undertaking in the world, but it has been found that the recent building of a railroad from the west coast of South America to the eastern plains has presented more difficult problems to the square mile than in any other undertaking of a similar kind hitherto attempted.

Indeed the difficulties that stood in the way were looked upon by English engineers as altogether insurmountable, and it was not until two American engineers, Wheelwright and Meigs, demonstrated practically that the task was possible. The Oroya railroad, which is a Peruvian enterprise, and recently described in our pages, and which is a most extraordinary series of switchbacks, grades and tunnels, reaches an altitude of 15,665 feet at one point, the greatest height in railroad construction, and is an enduring monument to the inventive faculty of Mr. Meigs, while the iron lines of Chile owe their conception to Mr. Wheelwright.

The work under consideration at this time was begun in 1910, and is properly speaking, the first trans-Andine line. It marks the beginning of the most active era of railroad building which Latin America has seen, and the year just closed has witnessed the completion of that singular line of communication, the Arica-La Paz Railway. The total length of the rail stretch from Arica to La Paz is 267 miles. Over the line it is 128 miles to the Chilean boundary and 139 miles from that point to Bolivia. The highest level that the road reaches is 13.987 feet, at a point approximately midway between the terminals.

As all who are acquainted with the railway system of Bolivia know, there are two other routes connecting La Paz, the capital, with the seaport. First, that of the Antofagasta and Bolivian line, 711 miles in length; and, second, the Peruvian Southern Railway, via Mollendo and Arequipa, 531 miles long. Obviously, the new route being only 267 miles, offers a much shorter haul. The increased cost of operating the rack system has to be weighed against the advantage in distance, but the projectors expect that dispite this there will be a balance favorable to the shorter route. Another feature of this railway system which is of considerable importance lies in the fact

ARICA, THE TERMINUS OF THE ARICA-LA PAZ RAILWAY.

that it is undoubtedly a long link of a new transcontinental route.

The aggressive railroad campaign now going on in Brazil will mean that that country will in a not far-distant day run tracks clear through to Curumba on the Bolivian frontier. When this is done it would be a comparatively simple matter to connect La Paz with Curumba, thus giving a great stretch of railway from the Atlantic to the Pacific across Brazil, Bolivia, and Chile. In connection with this possible development we must not forget the influences of the Panama Canal. The Isthmian transit will mean a short connection for Bolivian lines with the outer world.

Freights are of first consideration in railroad profits, and in this regard a very careful engineer has reported that the Arica-La Paz line should pay, over and above all expenses, about 10 per cent on the investment. But as all know there are so many factors in an enterprise of this kind that it is not advisable to predict just what the profits will be until after at least one year of running experience.

The country over which the lines pass is essentially mineral, and it is from the output of mines, marble deposits, and sulphur that the future profits will accrue. To begin with what is of most importance, we shall see what sulphur can be taken out of this section of the world. To anyone unacquainted with the varied uses to which this product is put, the fact that in the United States we find use for about 500 tons of sulphur a day may be a surprise.

The engineers who have made a thorough study of the district are unanimous in one regard. The tenor of their reports is that the sulphur deposits of Tacora on the Arica-La Paz line are the most important in the world. Ten to twenty million tons are considered a very low estimate of the contents of only the most superior field. In fact from the data available, the enormous quantities of mineral in this section are considered inexhaustible.

Another industry that has grown to considerable proportions is that of the exportation of copper from this district. The Corocoro Mine yields the greatest output at present. One gets some idea of the mineral resources of the Andes which seem to be "copper riveted," when your steamer lies two days off some insignificant town that hardly merits the name of port, while the four winches are loading the ship with great ingots of the metal. The continual procession of lighters loaded with the green mineral are towed out and take position alongside the forward and aft hatches, and while four of them are unloading simultaneously, you can almost feel the ship settle under the tremendous additional load.

INAUGURATING A NEW SECTION OF A RAILROAD IN BOLIVIA.

Referring again to the difficulties of construction though it may be said that the Andes Mountains rise to unparalleled pinnacles from a great granite ridge which forms the very heart of the range. This ridge is a bleak and barren wall, rising to shining summits of white that, when the sun sinks to the Pacific, picks up its rays to transmute them into a kaleidoscopic curtain of surpassing beauty. Yet there is a stern, forbidding hardness in the vision. It is as if that granite heart spoke through the volcanic incrustation to forbid these shores to the profaning foot of man. The picture is everywhere desolate.

In this forbidding region the rack-rail was the only available means of overcoming the ascent. It is the last resort in railroading. In this instance the track system is constructed in what is known as the 2-plate Abt plan. It is run upon a 6 per cent. maximum grade and totals approximately 28 miles, which in all porbability constitutes the longest uninterrupted stretch of rack railway which has been constructed in any part of the world.

Our frontispiece shows a view of Arica, which is about 880 miles from Valparaiso. El Morro the towering hill on the left, 855 feet above sea level protects the harbor on one side, and is fortified. Arica is the terminus of a road built by the Incas several centuries ago, connecting the port with La Paz. The road is still in good condition. There are excellent pier and dock works, which form part of the scheme of the railway. Freight will be handled by the most modern methods. Passenger service will be thoroughly American.

It may be briefly stated that the construction of this railroad owes its origin to lengthened negotiations that finally culminated in a treaty of peace and friendship between Chile and Bolivia and which was signed in 1904, and the newly opened line sprang from this agreement. A discussion of the political reasons that made the building of it necessary would lead us through many intricate byways of Chilean and Bolivian history and they need not be referred to at this time.

THREE-ARCH BRIDGE NEAR MAURI RIVER, BOLIVIA, ON THE ARICA-LA PAZ RAILWAY.

General Correspondence

Locomotive Tests.

Editor:—For the information of the readers, in general, of the Question and Answer Department of your valuable journal and of I. E. M., of Crew, England, in particular, would be glad if you would kindly publish the following supplementary to your answers to inquiry of I. E. M., which appeared in the December Journal.

On the road on which I am employed as Motive Power Inspector some very extensive dynamometer road tests, both in passenger and freight service, have been made recently, which cover some of the information inquired about.

(1.) It has been our experience that a Pacific type locomotive with cylinders 24 ins. by 26 ins., and designed with 55 square feet of grate area will give a much more satisfactory performance, both in fuel economy and steaming, than a similar engine with 64 square feet grate area. These locomotives are hauling trains of 700 flat tons regularly over 150 mile divisions on a schedule of 61 miles per hour and often make up five to eight minutes. The coal burn is 100 pounds of coal per mile.

(2.) These locomotives have 21-foot flues and are making from 140,000 to 180,000 miles, that is, they are making this number of locomotive miles before it becomes necessary to take engines to shop for purpose of having flues reset. We have not experienced any flue leakage or other trouble due to tubes sagging. This is considerably greater mileage than we were formerly obtaining with 15-foot flues.

(3.) We did not find that boilers with short tubes are the best steamers. It is true a larger nozzle tip can be used but where the engine is worked to maximum capcity the draft on the fire is extremely severe due to the absence of flue friction. The result of this is the front end temperature is extremely high, denoting that the heat in the escaping gases is not being properly utilized.

In regard to valve and cylinder lubrication for superheating it has been found that it is a decided advantage to introduce the oil into steam pipe as far from the valve chamber as possible. A single oil pipe to each side only is necessary and with the temperature mentioned and with the above arrangement of tallow pipes the locomotive should make 60 miles per pound of oil; this to include the lubrication of two air pumps.

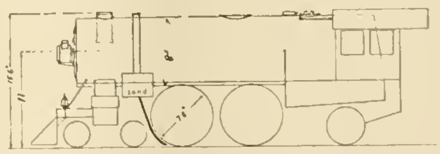
T. E. More.

Ft. Wayne, Ind.

Increased Size of Boiler.

Editor:

Now that the limit of length of passenger engines has been reached, the 4-6-2, why not utilize the entire space available for an enlarged boiler by placing the throttle and safety valve within. The accompanying design shows a boiler of about 8 ft. diameter pitted to a 4-4-2 with 78-in. wheels. The smokestack is almost entirely internal. A sand box is carried on each side with a large pipe extending from each one to the point where sand is usually carried, for the convenience of filling. The throttle is placed within the boiler with a large plate covering the hole through which it can be removed for repairs. This construction does not offer any more weakness than a dome. In the absence of the latter, steam must be collected by a perforated pipe extending six or eight feet along the top of the boiler, a thing which has been successfully done in other countries. The safety valve is likewise placed within the boiler. The front windows of



INCREASED SIZE OF BOILER.

the cab are 12 ins. wide, which is sufficient. The firebox being about 8 ft wide provides a large amount of heating surface at the end where it is needed.

An engine such as the one described, however, would have a high c. g., objectionable on some roads and therefore it might be desirable to lower the boiler and place the throttle and safety valve as usual. So why not reduce the diameter of the drivers and proportionally the piston stroke? For instance, instead of the frequent dimensions employed on 4-4-2's, i. e., 78-in. wheels and 26-in. stroke, let the wheels be 72 ins. and the stroke 24 ins., which figures out practically the same piston speed, and consequently there would be no more oscillation with the small wheels than with the large at high speed.

Wm. G. Landon.

New York, N. Y.

Boiler Inspection.

Editor:

The rules and regulations for the inspection and testing of locomotive boilers made effective by the Interstate Commerce Commission as of July 1, 1911, involves quite an amount of clerical labor in the line of preparation of certificates, keeping of records, etc., and a great amount of this work naturally devolves upon the round house office. As an aid in this connection the following system is suggested for use in these offices for the particular purpose of keeping conveniently an accurate, up-to-date and running record of the dates on which boilers of locomotives running out of a round house are due for the various inspections. In order to properly keep this record under this system, two date boards which may be numbered 1 and 2 are required, as described below:

The boards to be provided with slots into which pieces of celluloid, ⅜-in. by 3-in. or size as desired can be readily slipped, and to be provided with sufficient number of slots to accommodate all locomotives handled by a round house. Four slots must be provided for each locomotive record, however, to contain slips showing—Locomotive number—Date due for Monthly Inspection—Date due for Quarterly Inspection—Date due for Annual Inspection. In place of slotting the board to hold the date slips, circular pieces of celluloid may be used, and hung on small hooks screwed or hammered into the boards, but this detail can be handled as desired by the operator. The use of ink in marking the locomotive number and dates on slips is preferable to pencil, and it washes off neatly. The suggestion might be made that black ink be used for marking dates in current months and red ink for dates in future months, in order to more readily discriminate between inspections to be made in a present month and a future month. As seen below the date 12/22/1912 would appear in black ink, and dates 1/22/1913 and 7/22/1913 in red ink.

Locomotive Number 000	Date due for Monthly Ins. 12/22/1912
Wood Strip.	
Date due for Quarterly Ins. 1/22/1913	Date due for Annual Ins. 7/22/1913

From above it will be readily seen that locomotive 000 was due for monthly inspection on 12/22/1912, quarterly inspection on 1/22/1913, and annual inspection on 7/22/1913.

Assuming that on 12/22/1912, this engine was inspected in accordance with monthly requirements, we are then done with board number 1, as far as this loco-

motive is concerned, and slips of celluloid are transferred to board number 2, with the change in date showing inspections due for monthly, quarterly and annual inspections on 1/22/1913, 1/22/1913, and 7/22/1913, respectively.

This method continues each day as the various locomotives receive the various tests, and at the end of a month when all locomotives that were due in that month for inspections have been inspected, it is merely necessary to refer to board number 2, and the roster for the following month is all prepared, and as these locomotives on board 2 are tested as they become due, the date slips are transferred back to board number 1, it merely being a case of monthly alternation between boards number 1 and 2, and at any period in any month, you have a ready reference record showing just how you stand; and it can be perceived that after the initial start of this board system, the record is running and continuous. Of course the method to be pursued at the different round houses for procuring the dates on which irregular locomotives coming into a round house are due, is a matter entirely governed by local conditions, and as no doubt this information is now obtained for whatever record system is in vogue, this method is already established.

Briefly summing up, while this board system may appear to be a duplication of records, nevertheless the ready reference and up-to-date feature should easily overcome this point.

As a final and vital suggestion, it should be arranged to have these boards so located as to be free of access for reference to such employees as may have business with this department of round house practice. Additional slots may be used, if complete record is desired, comprising—Date due for removal of tubes; date due for removal of caps from all flexible staybolts, etc. This method will readily be found to be much more convenient than the general practise of bookkeeping. It is easily arranged and kept up to date and can be seen at a glance.

P. R. Lewis.

Jersey City, N. J.

Device Used When Changing Tires.

Editor:

Attached drawing shows device used in applying driving wheel tires, which is considered a labor saver and safety device. You will note that the clamp is welded to the support which holds the tire and when clamped to spoke of wheel it allows the tire to be in position to slip on wheel center when expanded to size. This device was suggested by Machinist J. S. Clark, of Clinton Shops.

Chas. Markel,
Shop Foreman,
C. & N. W. Ry.

Clinton, Iowa.

Days of Auld Lang Syne.

Editor:

Your issue of this month has stirred up old recollections and reminiscences in my memory. Reuben Wells was intimately known to me in his younger days. In 1851 I took a "Baldwin 8 Wheeler" engine which had just been put through a complete overhauling in the shop; flues were taken out, cleaned and reset; and, in fact, the engine was made as good as new. On my 212th trip an axle broke, and I had to go to the shop after a service of eleven months without losing a trip for repairs.

I left the Philadelphia & Reading employ and took an old "Braithwaite" engine called "Spitfire" to Scranton, Pa., to haul the iron that was used in the Lackawanna & Western Railroad. The rails were 90 lbs. to the foot, 30 ft. long. Reuben Wells took my engine, "Princeton," and started in to equal or beat my record. I never knew what the results were. The highest previous record to mine was made by a "Baldwin" engine, "Texas," 160 trips in ten months before going for a regular overhauling.

The reminiscences of S. J. Kidder struck an answering chord in my memory. About the time he mentions, Nathan & Dreyfus sent to the Philadelphia & Reading Railroad one dozen brass tallow cups to be used in lubricating the valves. I was then employed in a conglomerate position, being in charge of the signal tower service; inspector of all oils used by the company; looking after lost cars, etc., so I was in a good position to know what was done with the new oil cups. Some of them were put on different engines, but in a short time they were put aside, condemned by the engineers. Perhaps a prejudice against anything new interfered with the operation of these cups.

A year or two afterwards I was in the yard of the Philadelphia, Wilmington & Baltimore Railroad at Wilmington, and was surprised to see the Nathan & Dreyfus tallow cups on all the engines. I asked the nearest engineer if they were any good, and his answer was, "You bet they are." Just then a man whom I found to be the master mechanic stepped up to me and I made inquiries about the tallow cups on the engine steam chests. I said that I had been acquainted with a railroad where they had been tried and where the men had condemned them as no good. He said his men condemned them on trial, but he put a man on an engine and, on his report, gave the engineers their choice—to use the cups, or quit. None of them quit.

When, in 1885, I had a "Wooten Firebox" locomotive on the Atchison, Topeka & Santa Fe Railroad, she had only the old style oil cup on the steam chest. There was no means of oiling the valves except when not using the engine, and there were long grades of from 20 to 25 ft. At Raton, N. M., by a mere chance I saw a pair of Nathan & Dreyfus tallow cups, and I asked the master mechanic, Mr. Dotterer, to put them on for me. He did and they made an immense improvement in the working of the engine.

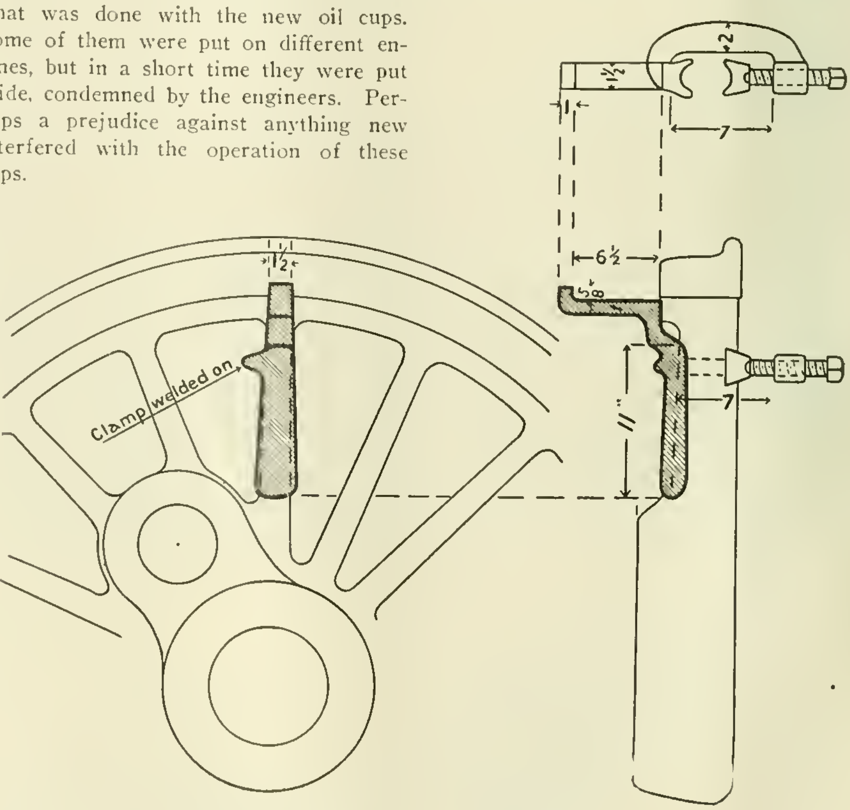
E. J. Rauch.

New York, N. Y.

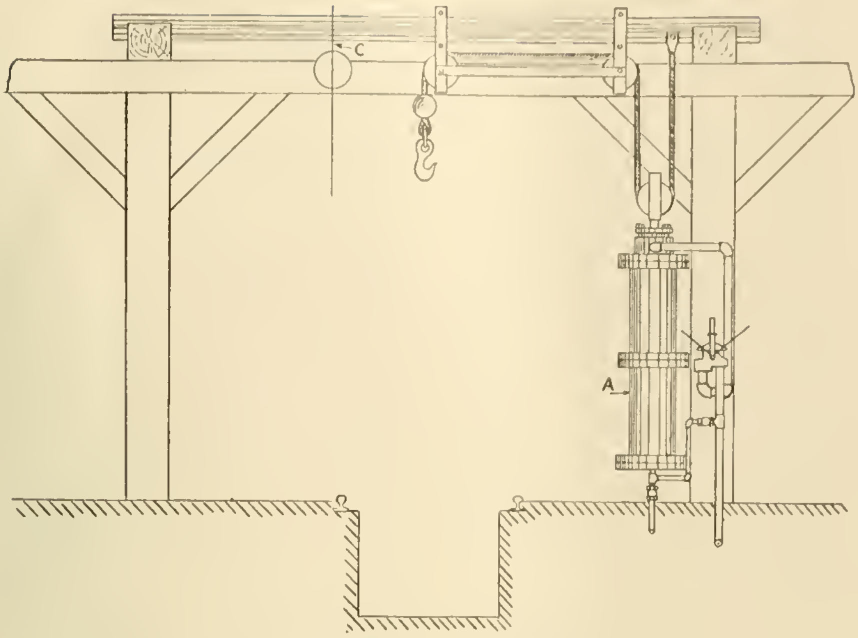
Air Hoist and Screw Drill.

Editor:

Enclosed are drawings showing a home made air hoist for use in roundhouse



DEVICE USED WHEN CHANGING TIRES.



AIR HOIST FOR ROUNDHOUSE.

and which is very serviceable for hoisting or lowering the heavy parts on locomotives. Fig. A shows the air cylinder with piping attachments which may be arranged to suit connections. Fig. B shows an extra attachment to put on at the position indicated at C, which is available to put in the hoisting cable from one side when it may be required to raise or lower air pumps on the locomotive.

The third drawing shows a ratchet or screw drill specially adapted for work in places where the space for drilling is limited. The drill may be made as short as possible and is combined with a feeding screw as shown. The end of the drill into which the thread is tapped may be made of a square form readily adaptable to an ordinary spanner wrench for turning the drill. The entire length of the device need not exceed four inches. Roundhouse men are well aware that it frequently happens that there are broken studs or bolts in spaces where the ordinary ratchet cannot be operated. A drill of this kind will be found not only of service in many instances, but will also help to avoid removing other parts of the locomotive to make room for the operation of a regular ratchet.

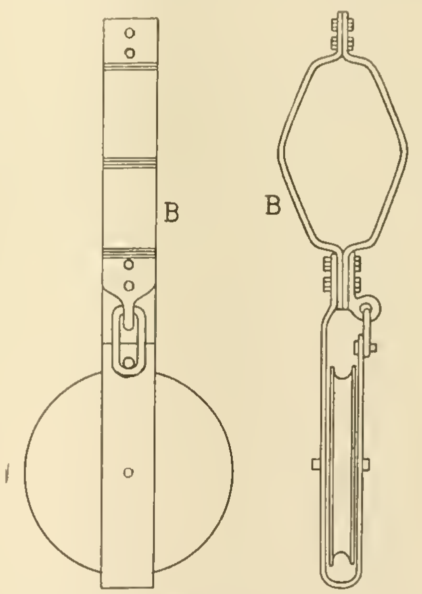
J. G. Koppell.

Montreal, Canada.

The Use of Sand.

Editor:

Sand is regarded by some people as an item of little importance, but it plays a very important part in the performance of locomotives; both in fuel economy and handling tonnage, if properly used in starting trains and pulling them over grades. It also prevents the wear of tires caused by unnecessary slipping. There is a certain grade of sand used on some roads that has considerable clay in it and scarcely any glass and is used instead of lake or river sand, account of short haul; and the difference in the price is very

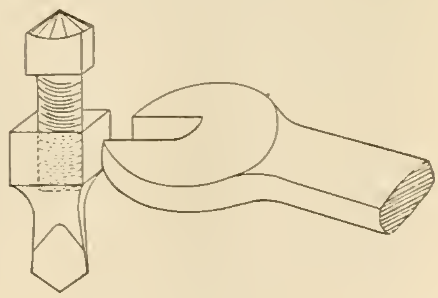


ATTACHMENT FOR AIR HOIST.

little if any; but if it should cost a little more it would be economy to get good sharp sand for locomotives use if it is available. Sand boxes and pipe joints are some times neglected and engines frequently arrive at terminals in rainy weather with wet sand in box and pipes clogged and very often the box is filled with dry sand before the wet sand is removed. The engineer may report the sanders cleaned and it is then necessary to empty the box to do the job right. The box and pipes should be absolutely free from moisture and the valves should have the same opening on each side.

Frequently an engineer will say that he cannot get over the road with one box of sand account of having to use the hand lever, claiming that he had too many brake pipe leaks to use the air sander as it would stick the brakes, and one valve would be one-half open before the other started to open, and in order to get sand on both sides he would be using too much sand on one side. With sanders adjusted evenly on both sides it is not always necessary to hold either device open for any length of time after train is started. If it is necessary to use sand to prevent slipping after train is in motion it can be used for a short distance at intervals, as there is always enough sand that sticks to the tire to hold the engine down for a couple of rail lengths after sand is shut off which is a saving of sand and lessens wheel friction. The engineer on arrival at terminals should open the air sander just before he stops at point of relief and then shut it off after engine is stopped, and move the engine a few inches beyond where he first stopped and open and close the sand lever, and when he gets down to inspect his engine he will note the operation of both sanders if there is sand in the box and will be able to report any defect in either device. If sand is working on one side only or is wet in box and pipes the hostler and round house foreman should be notified not to sand the engine until the wet sand is removed and the leaks repaired. Sand should be properly screened and handled by careful men as it is very essential that we should be able to depend on it to respond to any emergency at all times.

Not infrequently we find a piece of waste in box or in one of the pipes at the top which had been dropped in the box carelessly by the men sanding the engines and as a rule we generally find it in the left pipe which would indicate that it was placed there for the purpose of saving sand and labor, thinking that the engineer will not notice it as he can see the sand running on his side all right; but the wise engineer will not leave his terminal without sand working on both sides. As a rule when an engineer starts out on a run with a full box of sand he is not very stingy with it until he discovers that he has used about two-thirds of it and if he has only covered about one third of his trip, he will then have to do some figuring to complete the trip successfully if he is unable to get sand at some intermediate point. If an engineer will drop a little sand every time he starts his train he will find that the engine will



SCREW DRILL.

not slip so easy after train is started, and can get over the road with very little sand which will not only show a saving in sand and fuel, but will save the wear of tires.

We often notice a passenger engine slip a few turns starting at stations. The engineer takes a chance on her not slipping and if the engine slips he closes the throttle and drops a little sand, and if he would get the habit of dropping a little sand on every start he would never slip, and if he made a stop where the grade is ascending it would be policy to drop a little sand before he had come to a stop. Passenger engines usually stop at about the same spot at stations and when they try to start without sand they slip and this being done every day makes the rail very bad at that point and if the grade is ascending the next freight train following will surely slip at that point if the engineer is not on the alert and fails to drop sand where the passenger engines slip starting, and this one slip on the freight engine might cause him to double or reduce his train. Careless slipping causes tires to be ground down and also puts a hard glazed surface on the tread which takes time to wear it off and as long as tires are in this condition it requires considerable more sand to hold to engine down, which would cause us to drag a train through a heavy rail of sand which would not be necessary if this condition did not exist.

If sand boxes and pipe joints can be made water proof and a good grade of sand is used there should be no cause for stalling on hills, if the tonnage is not excessive and no brakes applied. There is nothing more aggravating or trying on an engineer's patience than to sit up on an engine trying to get over the road on a bad rail with a box full of wet sand or pieces of coal and waste lodging in the valve as fast as they are cleaned. With every thing in good working order we are still up against another proposition on long runs when the rail is wet, as the sand will clog up in the bottom of the pipes and it is necessary to jar the pipe to knock it out, and there should be some device used to keep the bottoms of sand pipes clean on long runs and in freezing weather this should be watched closely, as it will freeze solid in the pipe.

The general storekeeper of a certain trunk line advised me recently that there were more right hand brake shoes used than left hand shoes, and asked me if I could explain the cause. I advised him that this condition should not exist as the wear should be the same. I advised him, however, that it might be possible that a great many engines were running with the left sand pipe stopped up, which would cause the right shoes to wear out faster if sand is used in making stops, and if such is the case, it not only lessens the efficiency of the power, but it works a hardship on the mechanical department.

F. E. Patton.
Southern Ry.

Columbus, Miss.

Corrugated Fireboxes.

Editor:

I was very much interested in reading your article headed "Improving the Loco Boiler," which was in the December issue, and I heartily agree with you that the locomotive has had considerable attention paid to its construction, but still remains an unsatisfactory product.

To relieve some of the troubles, ingenious inventors have been at work on the staybolts, letting the boiler with its level plates remain as heretofore. And it is in these same level plates that the entire problem exists, namely, the expansion and contraction.

This question has been solved in the Wood boilers by the formation. These boilers have had ample time to prove that the existing conditions of the locomotive boiler have been bettered and they will prove a more satisfactory product now, as the question of producing them is beyond cavil.

Their strength is proved to be nearly eight times the strength of the level plates and the statistics produced by the New York Central officials, on whose road they have been working, shows that the boiler has benefited in heating surface. These same statistics or reports show a clear gain in fuel over engines doing the same work and of the same class, and with 14 pounds less boiler pressure.

These facts are worth the attention of those interested in locomotive boilers and a feat hitherto not known to boilers in locomotives is worthy of note, namely, that no staybolts were broken between these formations.

Trusting the advent of the New Year will bring with it a stronger interest in the working out of these improvements than has been shown up to the present, especially since such a quantity of data is to be had from the most reliable sources, I am,

Wm. Heaword, M. E.

Media, Pa.

Old-Time Railroad Reminiscences.

By S. J. Kidder.

For a few years following, hand oil cups were used, they, in turn, being replaced by sight-feed lubricators similar in operation to those in use at the present time. The 69 locomotives of the B. & M. were mostly of one build (16 x 24 inch American type, Manchesters), and all with the exception of one of the last two lots received had open fire boxes, too small to burn the coal, which was of medium quality, in a manner to make steam freely. The general master mechanic, who was something of an inventor, had little use for his neighbor Jarriet, Gen. M. M. of the C. B. & Q., an active and very progressive man and, I think, the first to successfully burn western coal in small fire box locomotives. This had been accomplished by putting a water arch in the fire box and a diamond stack having a long barrel and abnormal opening through the netting, all so designed as to give draught and prevent the escape of sparks as well. This feeling on the part of the B. & M. Gen. M. M., was by no means allayed when, through influences he could not control, nine engines were purchased having the appliances of his hated rival. It was my good fortune to get one of them, the "Camanche," which proved the most economical and freest steamer I ever ran.

Regardless of this, which also proved true of the other new engines, the monthly performance sheets, following the one showing their coal record during the first month in service, failed to indicate any saving of fuel over the open fire boxes, regardless of the fact that one tank of coal took them over the 115 mile division while two were required for the older engines. Ruminate as I could I failed to solve the problem of one from two leaves two, as my engine was making more than 50 miles to the ton, the open boxes 25 to 28, still on the sheet the Camanche came within the latter figures. The chief clerk was a good friend of mine and I finally appealed to him. "Teed, how is it that my engine goes over the division with a coal consumption about half that of the open boxes, never doubles a hill, yet makes no better mileage on coal than the open boxes?" He smiled, began rumaging in a pigeon-hole and as he extracted therefrom a personal letter from the Gen. M. M., to the master mechanic, turned and handed it to me with the remark "Read that and say nothing." Its contents were to the effect that the water arch engines were showing up too much coal mileage and therafter the monthly statements must indicate no greater mileage per ton of coal for these engines than any of the others. This action of the Gen. M. M. no doubt sealed the fate of patent water arches and stacks on the B. & M., as the next lot of new engines came without them. Some years later the C. B. & Q., which meantime had taken the B. & M. into its fold, purchased some forty consolidation engines all of which were placed in service on the Iowa division.

These engines had 20 x 24 inch cylinders but were not of sufficient boiler capacity to make them good steamers. With the quality of Iowa coal generally used they did fairly well though a good deal of urging and adroitness on the part of the engineer and fireman was frequently required to get sufficient steam to do the work, the open throttle and injector

seemingly vieing with each other to thwart the efforts of the engine crew. Quite unexpectedly one December day, during an intensely cold snap, a consignment of coal from a neighboring state was distributed at the sheds along the division. The coal was composed largely of black-jack and other impurities which quickly formed into huge clinkers, and before the first day of burning the new fuel was over complaints were coming in by telegraph, mail and verbally of delays to trains, a result of the engines not steaming. Upon learning of the trouble the road foreman of engines at once got busy by mounting a consol. just starting out with a clean fire and a tank of the new coal.

With the thermometer registering below zero the train pulled hard, but to pull steam out of the 234 was an even more difficult task.

Reaching Albia, 25 miles away, an attempt was made to clean the fire and for nearly two hours the road foreman, engineer and fireman labored vigorously with a slash bar and coal pick in an endeavor to break the clinkers sufficiently to permit their removal through the fire box door, and which was finally accomplished. Later in the day the road foreman started out on a passenger engine. Woodburn was reached with 70 pounds of steam in the boiler and as the foot of a heavy grade confronted the 234 less than one-fourth of a mile away, there was nothing to do but delay the train until the fire box could be cleaned. The road foreman returned to headquarters late that night and in a quandary as to why good coal, mined adjacent to the division, should be substituted with an inferior product shipped from a point nearly 150 miles away. Reaching his office he found a telegram signed by a general officer, calling a meeting of superintendents, master mechanics and road foremen the following day. As it had already come to the knowledge of several local officers that the one calling the meeting was in some way interested in the colliery from which this coal had come, the prospect was not especially inspiring to those who were to attend, it being realized the combination of circumstances was such that to answer the questions which would no doubt be propounded would be perplexing.

Upon opening the inquiry the Asst. Gen. Manager emphatically stated "the object of the meeting was to ascertain why the Iowa division, which up to that time had enjoyed an enviable reputation, had all at once fallen down," etc. He then called on one after another of the superintendents and master mechanics for an explanation, but other than the confusion and delays taking place on the road they had no knowledge or theories to offer.

The road foreman first referred to was about to leave the service, having already tendered his resignation, and while the enquiry was going on had noticed that one of the master mechanics occasionally gave him a knowing look, the significance of which was to become known shortly.

After quizzing the division officers the assistant general manager said: "Well, gentlemen, we are here to ascertain what the trouble is. If it is with the engines we will get other engines (a well put up bluff); if it is with the men we will get other engineers." Then, very vehemently "What I am here for is to get the facts and I am going to get them too!" Then up rose the master mechanic, giving the road foreman a side glance as he did so, and said: "I think there is but one man here who really knows what the trouble is," and, designating the road foreman, he resumed his seat. Upon being called up the road foreman stated that "the changed conditions were beyond the control of the officers of the division. The same engines were on the runs as had been; the same engineers were running the engines; the trouble was with neither, but with the inferior Illinois coal recently received." There was a slight murmur, the meeting came to an abrupt close and—on the following day all engines were again feeding on the Iowa product.

The Power of the Mind.

Some people give up all mental effort as soon as they get sick or afflicted, but there are some minds that no pain or suffering can subdue. The most powerful warship afloat, which was launched in the Thames in England last February, was built by a man who can neither sit nor walk. The most famous of our racing yacht designers is blind, but he could build a boat that was good enough to defend the America Cup year after year.

The head of the Thames Iron Works Company that built the Thunderer is a victim of chronic rheumatism and passes his days lying on a trundle bed upon which he is wheeled all over the immense works and oversees everything that is going forward. He knows every foreman in the shops and has the designs of every piece of machinery by heart, and they point to him as a wonderful example of the truth of the old adage, "The eye of a master can do more work than a thousand hands."

The Lehigh Valley Working for Safety.

An excellent proof of the good work that may be accomplished by an earnest and united effort in the cause of greater safety on railroads is being admirably exemplified by the Safety Committee composed of both officials and employees on the Lehigh Valley Railroad. Enough time has now passed since the committee was established to show the value of this kind of co-operation in the prevention of accidents. The men in the ranks—engineers, firemen, conductors, trainmen, shopmen and track laborers—have entered into the scheme with even more enthusiasm than was expected, and they make suggestions that are often of great value to the management.

There is a general safety committee and a committee for each division. Every branch of the service is represented on the division committee by one employee, the make-up being as follows: An engineer, a fireman, a conductor, a trainman, a switchman, an agent, and a foreman. On the general committee are the general manager, the superintendent of motive power, the maintenance of way engineer, and whatever other officers or employees the general manager may appoint.

All employees on the system are invited to make suggestions, and they have taken free advantage of the invitation. On each division the man who makes the best suggestion towards increased safety of operation is rewarded by one month's vacation with pay, in addition to an "honor button." Besides these prizes and distinctions, annual passes are granted employees with clear records for an entire year.

This committee work is supplementary to, not a substitute for, the existing provisions for the protection of passengers and employees. It is particularly effective in reducing the number of so-called "little" accidents. These, though they do not attract great attention when they occur, are chiefly responsible for the total of any one year. They are largely the result of carelessness of one kind or another. "Familiarity breeds contempt" is proven true by the way in which employees begin to take chances when they have been in service some time. One of the most important features of the present movement therefore, is the attempt to impress upon railroad men the extent of suffering inflicted upon wives and children every year as the result of such accidents.

It was only after a great deal of study that the safety committee plan was finally put into effect. It was passed upon by the highest officers of the company—the president and vice-presidents and the general manager gave their personal attention to the details of organization—and now the interest taken by the men is justifying their efforts.

Railway Construction in Palestine.

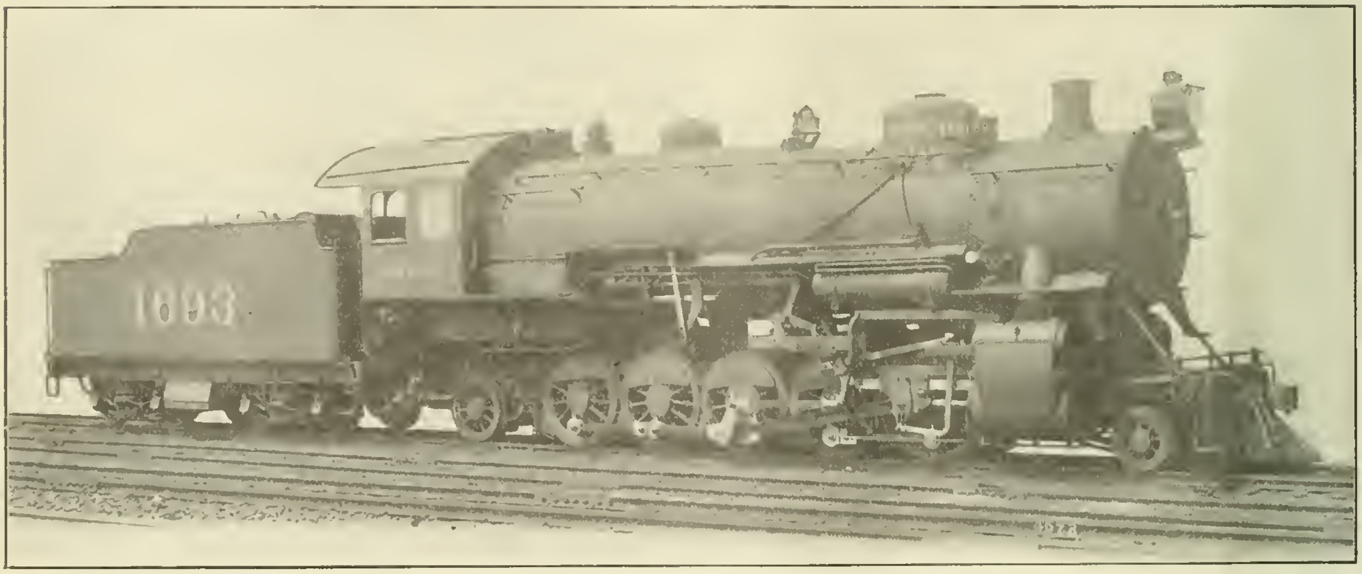
Various reports of the branch of the Hedjaz Railway, now under construction by the Turkish Government from Afuleh to Jerusalem, have been published in European papers, and there seems to be an impression that the project is nearer completion than it really is.

Afuleh is a station of the Hedjaz or Mecca Railway on the plain of Esdraelon. It is proposed to construct a branch line from there, via Jenin and Nablus, to Jerusalem, and possibly to continue the line farther south to Hebron and Beersheba.

New Locomotives for the Atchison, Topeka and Santa Fe

The Atchison, Topeka & Santa Fe Railway System has recently received 70 locomotives from the Baldwin Locomotive Works, as follows: 20 Santa Fe (2-10-2) type for oil burning; 10 Pacific (4-6-2) type for oil burning; 10 Pacific (4-6-2) type for coal burning; 10 Consolidation (2-8-0) type for oil burning; 14 Switching (0-6-0) type for oil burning; 6 Switching (0-6-0) type for coal burning.

In general, the new locomotives are duplicate of others already in service on the Santa Fe System for several years. In most instances where revision of design of individual parts has been necessary because of weakness, the new parts have been made interchangeable with the corresponding parts of older engines, thus reducing the number of patterns as well as the amount of repair part stock. The boilers of all the new engines have radial stay fireboxes and all the locomotives for road service are equipped with Schmidt superheaters.



SANTA FE 2-10-2 TYPE LOCOMOTIVES FOR OIL BURNING.

SANTA FE TYPE LOCOMOTIVES.

The first locomotives with this wheel arrangement were placed in service by the Santa Fe System in 1903, and during the years 1903-1907, a total of 160 locomotives of this type were built by the Baldwin Locomotive Works for service on the mountain divisions of the Santa Fe. Some of these engines have undergone extensive alterations by the railway company since they were first constructed, and several have been converted into Mallet compounds by the addition of forward units. The steam piping is arranged in accordance with recent practice, and superheated steam is delivered direct to the steam chests through outside pipes. Inside admission piston valves, 16 in. in diameter, control the steam distribution. These valves are driven by Walschaerts gear and are set with a lead of ¼ in. The Ragonnet power reverse mechanism has been applied as a result of continued trial on previous engines of other classes. The main cylinders are oiled by a five-feed lubricator which has a lead to each steam pipe and one to each cylinder barrel.

As in the ten-coupled locomotives of the Santa Fe type recently built for the Chicago, Burlington & Quincy R. R., counterweights are keyed to the main axle between the frames, to compensate for deficiency of weight in the wheel centers.

The equipment of these locomotives includes cylinder relief valves, also drifting valves of the Sheedy pattern. Flange lubricators are applied to the leading pair of driving wheels. The oil-burning equipment is in accordance with the railway company's practice. A two-inch Booth burner is used and it is placed in the forward end of the firebox.

The principal dimensions are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 28 ins. x 32 ins.

Driving wheels—Diameter, 57 ins.

Boiler—Diameter, 80¾ ins.; pressure, 170 lbs.

Firebox—Length, 103 ins.; width, 78 ins.

Tubes—Number, 251—2¼ ins.; 36—5½ ins.; length, 21 ft.

Wheel base—Driving, 19 ft. 9 ins.; rigid, 19 ft. 9 ins.; engine, 35 ft. 10 ins.; engine and tender, 66 ft. 4 ins.

Weight in working order—On driving wheels, 248,900 lbs.; on truck, front, 21,400 lbs; on truck, back, 25,600 lbs; total engine and tender, about 470,000 lbs.

Heating surface—Tubes, 4,174 sq. ft.; firebox, 193 sq. ft.; total, 4,367 sq. ft. Grate area, 58.5 sq. ft.; superheating surface, 910 sq. ft.

Tender—Wheels, diameter, 34¼ ins.; capacity, water, 900 gals.; oil, 3,300 gals.

Service, freight.

PACIFIC TYPE LOCOMOTIVES.

These locomotives are generally similar to the 28 balanced compound Pacific type engines built for this road in the previous year, by the Baldwin Locomotive Works. The tractive force exerted, working compound, is 34,000 pounds.

The inside (high pressure) cylinders, are placed on an angle of 7½ degrees, with their centers 26¾ ins. above the outside cylinder centers, measured on the vertical center line of the cylinder casting. The high pressure piston rods are somewhat shorter than the low pressure, in order to allow sufficient clearance between the main rods and the first driving axle. When the inside cranks are on the back dead center, the crossheads are immediately above this axle. The inside guides are of the Laird type, this design having been adopted because it provides a maximum amount of clearance under the crossheads. The transverse bracing of the frames in a four cylinder balanced engine presents some difficult problems, but in the locomotives under discussion a most satisfactory arrangement has been worked out.

The coal burning locomotives are equipped with brick arches, and the grates and fire-door are operated by pneumatic power. The ash pan has three hoppers, with swing bottoms which can be operated independently of each other. Special attention has been given to equipping the locomotives so that they can be conveniently handled.

Their principal dimensions are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 17½ ins. and 29 ins. x 28 ins.

Driving wheels—Diameter, 73 ins.

Boiler—Diameter, 70 ins.; pressure, 210 lbs.

Firebox—Length, 109⅝ ins.; width, 76¼ ins.

Tubes—Number, 199—2¼ ins.; 26—5½ ins.; length, 21 ft.

Wheel base—Driving, 13 ft. 8 ins.; rigid, 13 ft. 8 ins.; engine, 35 ft. 1 in.; engine and tender, 66 ft. 11¾ ins.

Weight—On driving wheels, 163,500 lbs.; on truck, front, 54,500 lbs.; on truck, back, 50,700 lbs.; total, engine and tender, about 440,000 lbs.

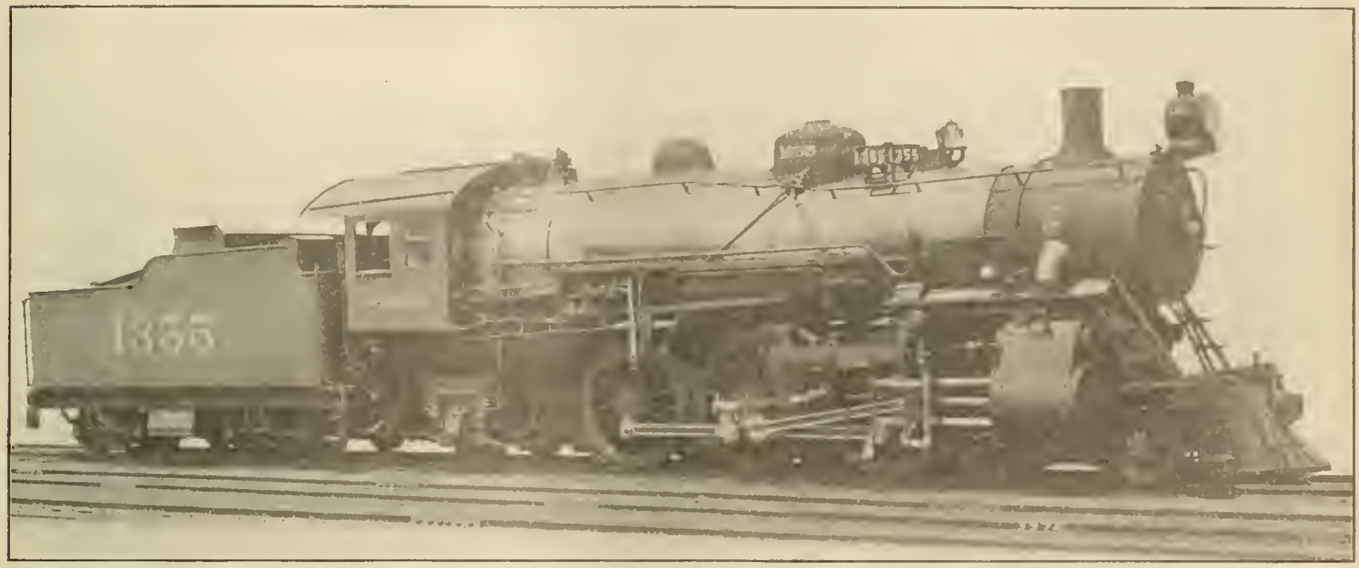
Heating surface—Tubes, 3,233 sq. ft.; firebox, 181 sq. ft.; firebox tubes, 29 sq. ft.; total, 3,443 sq. ft.

Grate area, 57.6 sq. ft.

Superheating surface, 619 sq. ft.

Tender—Wheels, diameter, 34¼ ins.; capacity, water, 9,000 gals., fuel, 12 tons.

Service, passenger.



PACIFIC TYPE, 4-6-2, LOCOMOTIVES FOR THE SANTA FE RAILWAY.

CONSOLIDATION TYPE LOCOMOTIVES.

These locomotives exert a tractive force of 48,800 pounds, and carry an average weight of nearly 49,000 pounds on each pair of driving wheels. The general design is based on that of Consolidation engines which were placed in service by the railway company in 1908.

A wagon-top boiler with wide firebox is used in this design, and the front portion of the mud ring is sloped to secure sufficient depth at the throat. The staybolts are so spaced that a brick arch with water tubes can be applied, if at any time it is desired to change the locomotives to coal burners.

The frames are 4½ inches wide, with double front rails. A transverse brace, extending the full depth of the pedestals, is placed midway between the second and third, and third and fourth axles respectively. The firebox is supported by sliding shoes in front and an expansion plate at the back.

CONSOLIDATION 2-8-0 TYPE LOCOMOTIVES FOR THE SANTA FE RAILWAY.

Their chief dimensions are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 23½ ins. x 32 ins.

Driving wheels—Diameter, 57 ins.

Boiler—Diameter, 78¾ ins.; pressure, 185 lbs.

Firebox—Length, 95½ ins; width, 71¼ ins.

Tubes—Number, 256—2 ins., 34—5⅜ ins.; length, 14 ft. 9 ins.

Wheel base—Driving, 15 ft. 6 ins.; rigid, 15 ft. 6 ins.; total engine, 24 ft. 6 ins; total engine and tender, 58 ft. 27⅞ ins.

Weight—On driving wheels, 195,500 lbs.; on truck, 30,800 lbs.; total engine and tender, about 385,000 lbs.

Heating surface—Tubes, 2,658 sq. ft.; firebox, 200 sq. ft. Grate area, 47.2 sq. ft.

Superheating surface, 565 sq. ft.

Tender—Wheels, diameter, 34¼ ins.; capacity, water, 8,500 gals.; oil, 3,300 gals.

Service, freight.

Catechism of Railroad Operation

Questions and Answers.
Second Series.

The Mallet Articulated Locomotive.

By F. P. Roesch.

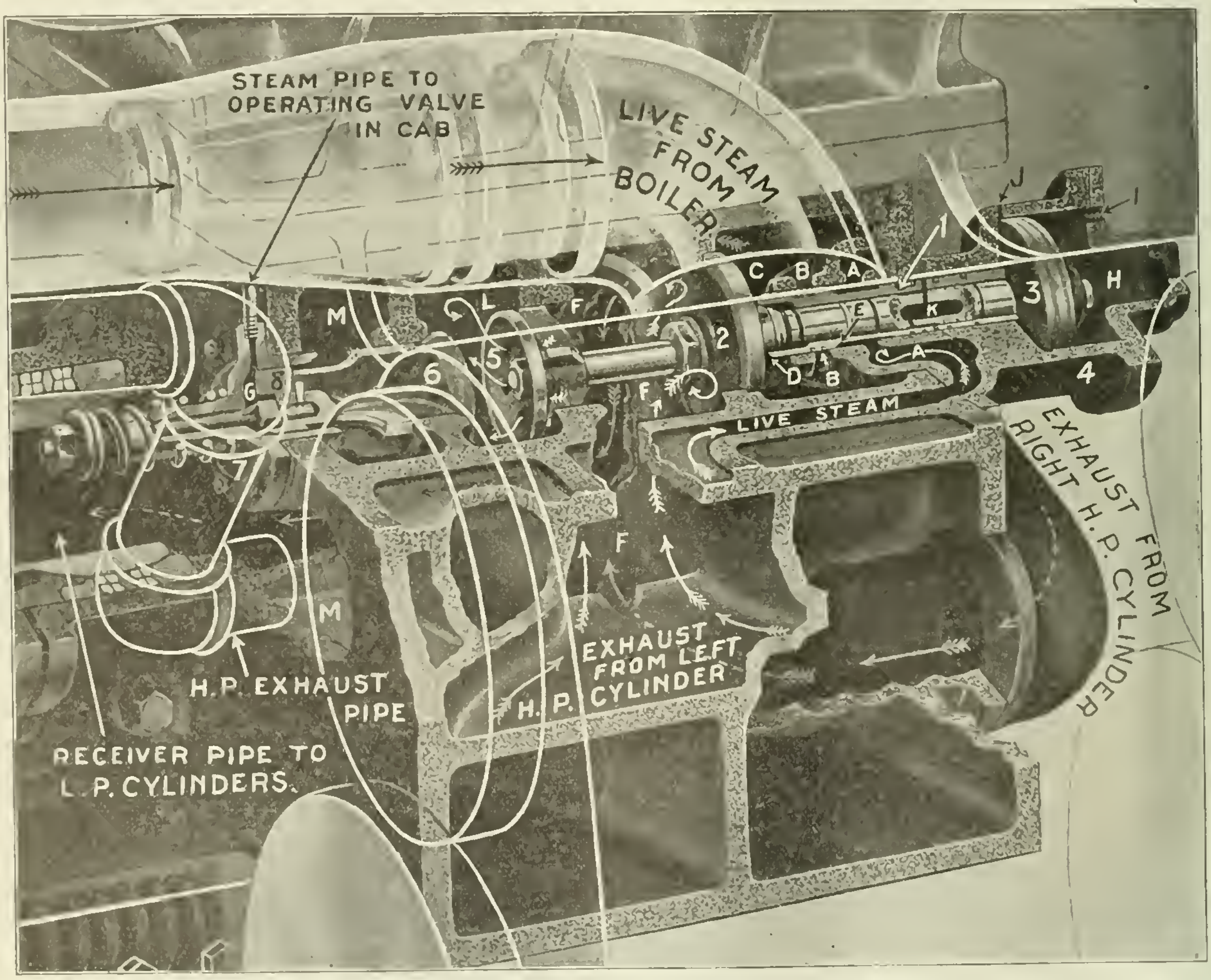
(*Continued from page 444.*)

Q. What would you do in case of failure of a portion of the valve gear on the rear engine?

On the American type locomotive, the intercepting and reducing valves would supply steam to the low pressure cylinders when the throttle was opened.

Q. What would you do in case of broken rods, pins or guides on either engine?

A. Handle practically the same as for a similar breakdown on an ordinary slipping and the high pressure was not, the low pressure engine would soon use up all the steam in the receiver, thereby stopping the slipping. This will not apply, however, with the American type locomotive, if the separate exhaust valve was open, as in this case the high pressure engine would continue to slip unless the throttle was eased off or partially closed.



POSITION OF THE INTERCEPTING VALVE WHEN THE PREDETERMINED MAXIMUM PRESSURE IN THE RECEIVER PIPE HAS BEEN EXCEEDED.

Reducing Valve or Sleeve (1) is closed. Live steam is cut off from the receiver until the pressure is reduced to the proper amount.

A. Handle practically the same as for a similar breakdown on a simple engine.

Q. Would it be possible to bring the locomotive in under its own steam in case it became necessary to disconnect both valves on the rear engine? If so, how?

A. Yes; the engine could be brought in under its own steam with the low pressure cylinders by simply opening the starting valve on a Baldwin locomotive. engine of the ordinary simple type.

Q. What would you do in case either engine started slipping when working steam?

A. Would drop sand and keep throttle open, as if the high pressure engine were slipping; it would, soon develop so much back pressure in the receiver pipe as to choke the high pressure engine down; whereas, if the low pressure engine was

Q. Would you consider it necessary to oil the front engine bearers?

A. Yes. These should be kept lubricated the same as any other part of the locomotive, in order to enable the boiler to swing freely.

Q. When inspecting this type of locomotive, what portion would you consider most important to inspect thoroughly?

A. The connections between the two

engines, as failure of these connections—that is, the draw bar rigging and pin—is liable to cause serious damage by the forward engine running out from under the boiler.

Q. How would you start a locomotive of this type?

A. Always open the cylinder cocks before opening the throttle. With the Baldwin type, if the train is heavy, open the starting valve. With the American type, try to start the train with the reverse lever down in the corner. If the engine can not start the train in this way, open the emergency operating valve in the cab by pointing the handle to the rear.

Q. After the train is started, how would you handle the locomotive?

A. After a speed has been reached of three or four miles per hour, close the starting valve, on the Baldwin type, and close the emergency valve, on the American type, as you would simply be burning more coal with these valves open without getting any more power out of the engine.

Q. How would you proceed if you were about to stall on a grade?

A. With either engine, if the speed is below three or four miles per hour, proceed the same as when starting a heavy train.

Q. In what position would you carry the reverse lever when drifting?

A. At about three-quarters stroke or more.

Q. What attention should be given the power reversing gear?

A. Keep the oil cylinder full of oil, and the piston rod packing on the oil and air cylinders tight. Always see that the latches of both reverse levers mesh in the teeth of the quadrant. Whenever they do not, report it.

Q. What attention should be given by-pass valves?

A. They should be reported to be cleaned periodically, in order to keep them from getting gummed up and sticky.

Q. What would be the effect if a by-pass valve were stuck open or stuck shut?

A. If stuck open, they will cause the engine to blow. If stuck shut, they will cause the engine to pound when drifting.

Q. What attention should be given the relief valves on low pressure steam chests and cylinders?

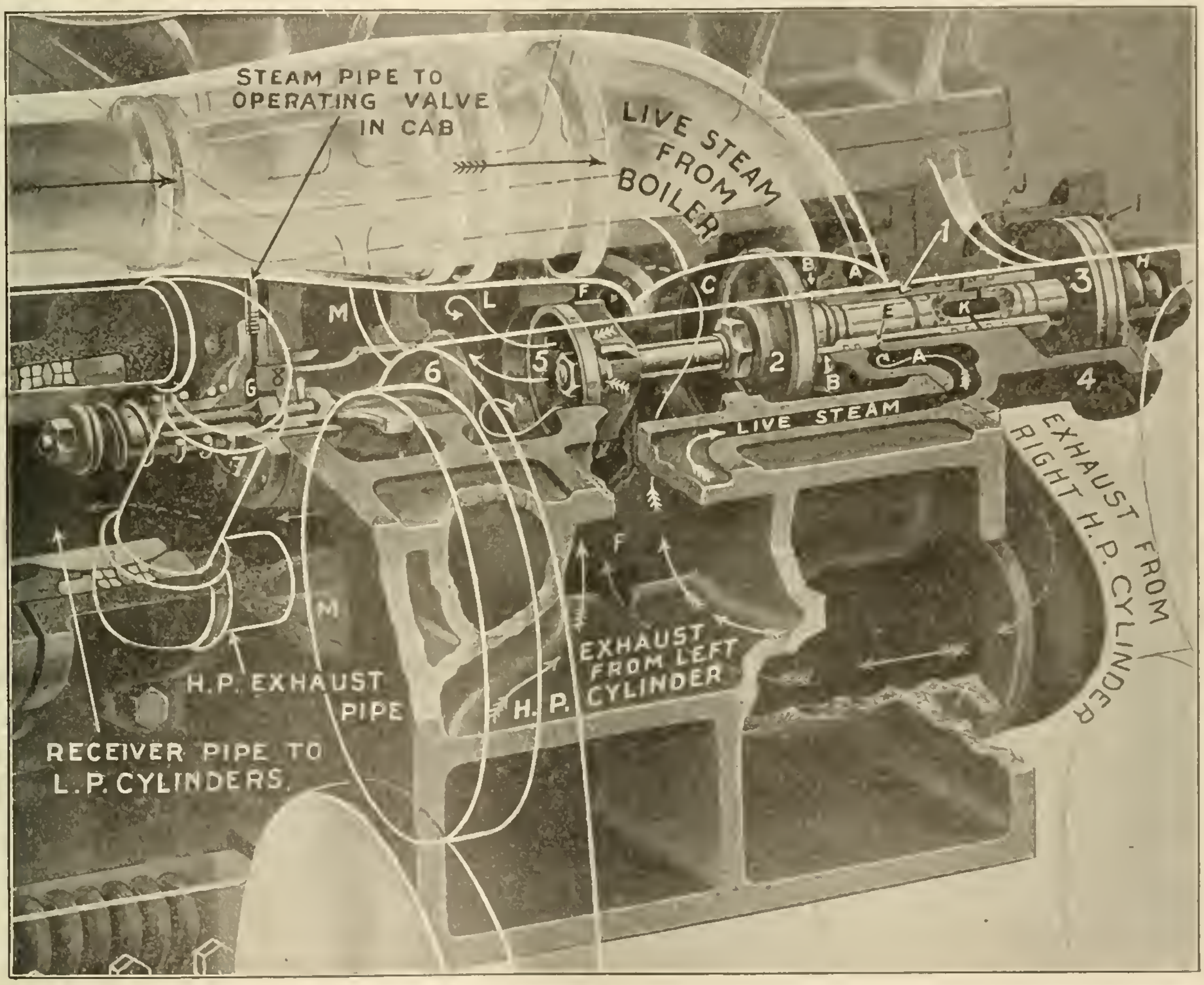
A. They should be tested about once a month, in order to see that they open at the proper pressure.

Q. How would you handle the intercepting valve used in connection with the American type locomotive, so far as lubricating it, etc., is concerned?

A. Give it a liberal feed of oil for about one minute before starting, and occasionally during long runs where the throttle is not shut off for a considerable length of time. Except for this, one drop of oil about every four or five minutes, when running, is ample.

Q. Beside the intercepting valve, what other parts of an articulated compound locomotive should be oiled that are not found on the ordinary locomotive?

A. The sliding boiler-bearing on the front engine; the ball joint in front of the high pressure cylinder; the upper or rear ball joint of the exhaust pipe; the lower or front ball joint of the exhaust pipe; (these ball joints need only be oiled before starting, as one oiling should be sufficient for the trip;) the bolt in the



INTERCEPTING VALVE IN COMPOUND POSITION.

Intercepting Valve (2) is open, Reducing Valve (1) and Emergency Valve (6) are closed. Live steam is cut off from the receiver pipe and exhaust steam from the high pressure cylinders is admitted.

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flexible connection connecting the two engines; the ball bearing of the vertical suspension or trim bolts, which connect the upper rails of the front frames with the lower rails to the rear frames; the ball bearing of the floating columns, if any; the piston rod packing of the cylinders of the power reversing gear; the air cylinder of the power reversing gear, by means of the plug in the top of the cylinder; about once a week will be often enough for the air cylinder.

Q. What is the arrangement of cylinders on Mallet compound engine?

answers apply to American type engines only except as noted.)

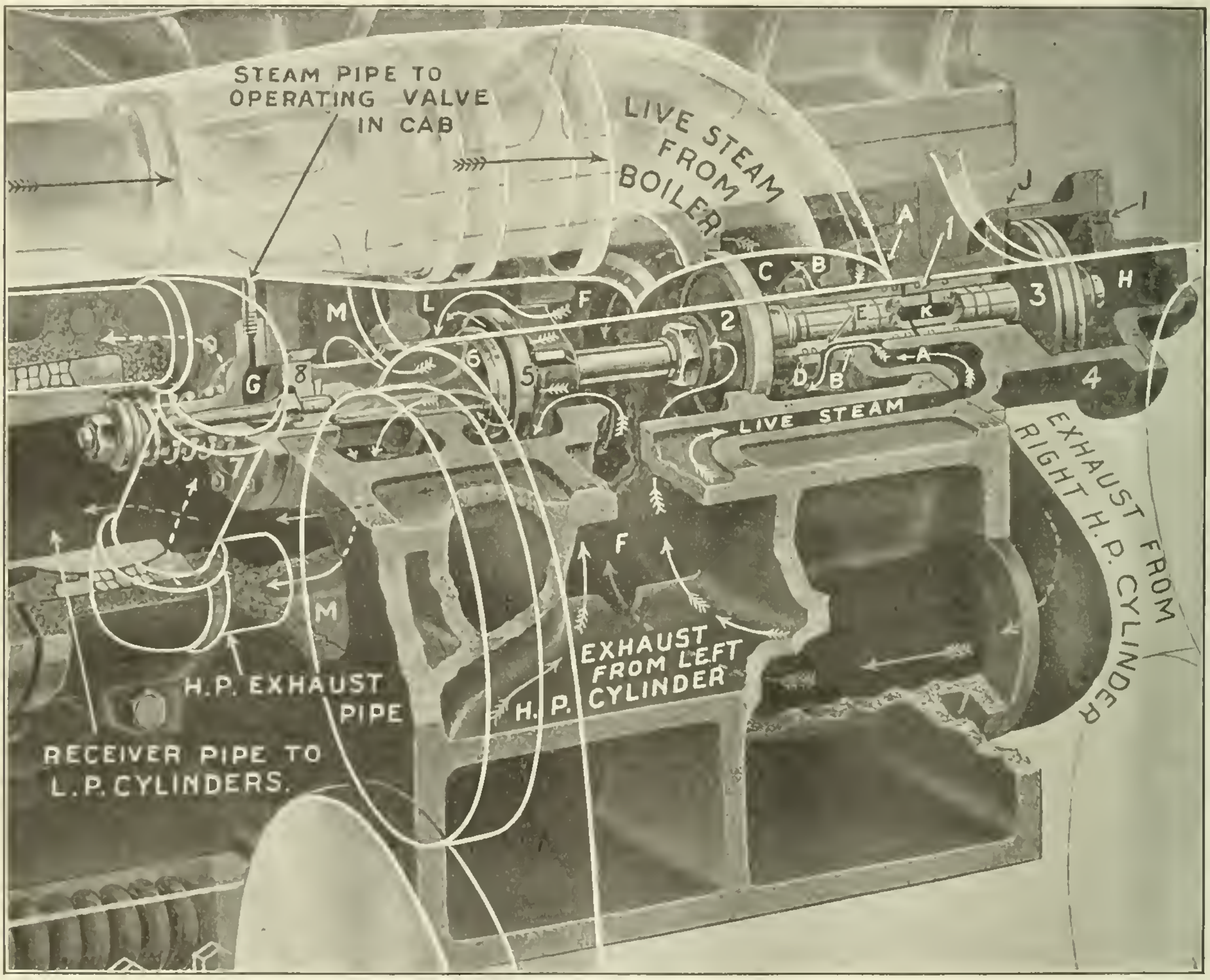
Q. Does the engine work simple or compound when first started?

A. Simple.

Q. When does the Mallet engine work compound?

A. When the receiver pressure has reached the desired amount, which is about four-tenths boiler pressure, thereby closing the intercepting valve.

Q. When the engine is working compound, what change is necessary to make the engine work simple?



INTERCEPTING VALVE IN SIMPLE POSITION.

Emergency Valve (6) and Reducing Valve (1) are open and Intercepting Valve (2) is closed. The exhaust from the high pressure cylinders is released to the atmosphere, the high pressure cylinders are relieved of receiver pressure and live steam is admitted to all cylinders, giving 20% increase in tractive power.

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A. High pressure cylinders rigidly attached to the boiler and rear engine; low pressure cylinders rigidly attached to the frames of the forward engine, but not attached to the boiler.

Q. Describe the make of valves used on high pressure engines and on low pressure engines.

A. As a rule, piston valves are used on the high pressure engines and "D," or slide, valves on the low pressure engines. (The following questions and

A. Open the emergency valve in the cab, which causes the separate exhaust valve to open. This takes the pressure off the end of the intercepting valve, allowing it to open and live steam to pass through the reducing valve direct to the low pressure cylinders.

Q. How would you determine if the intercepting valve was stuck open? If stuck closed?

A. If the intercepting valve was stuck open, the engine could not be converted from compound to simple, as, in this case, opening the separate exhaust valve would allow part of the steam from the receiver to pass out through the separate exhaust and, consequently, but a small portion would pass to the low pressure cylinders and the engine would lose power and, if on a hard pull, would probably stall. It might also be noticed by the high pressure engine slipping.

If the separate exhaust valve was stuck closed, the locomotive could not be converted from simple to compound and, unless the separate exhaust valve was opened, the pressure would bank up in the receiver until it balanced on both sides of the high pressure piston, and, in this case, as before, if the engine was on a hard pull it would probably stall. You could tell if the intercepting valve stuck closed by first opening the separate exhaust valve and noticing if the engine picked up speed, then closing the separate exhaust valve, by means of the emergency valve in the cab, and noting if the speed reduced quickly.

Q. Describe how steam is conveyed from high to low pressure cylinders.

A. As the steam is exhausted from the high pressure cylinders it passes on into what is termed the receiver pipe, which connects the exhaust chamber of the high pressure valve with the steam chamber of the low pressure valve, and when the engine is working compound the movement of the low pressure valve allows the steam from the high pressure cylinders to enter direct into the low pressure cylinders. When the engine is working in simple position the low pressure engines operate with live steam direct from the boiler, while the steam exhausted from the high pressure cylinders into the receiver passes by way of the separate exhaust valve direct to the nozzle.

Q. In starting the locomotive, if the forward engine does not take steam, what is the trouble?

A. The reducing valve is stuck shut, as, with this type of engine, unless the reducing valve is open there would be no steam in the low pressure cylinders until, after the high pressure cylinders have exhausted.

Q. What would you do if a by-pass valve was stuck open or stuck closed?

A. If one of the by-pass valves should stick open it would cause a severe blow, and, if it could not be closed in any other manner, the cap on the end of the chamber should be removed and the valve forced into closed position with the handle of the coal pick. At the same time, while the cap is removed, see that the small port at the end of the by-pass valve chamber is open. If the valve is stuck shut the engine would not drift freely, and, if necessary to do considerable drifting before reaching the end of the terminal, it is advisable to take off the valve chamber cap, remove the by-pass valve, clean it with coal oil and replace. The sticking of the by-pass valves is generally caused by the smokebox gas being sucked into the cylinder, on account of the reverse lever being carried too high up when the engine is drifting. The reverse lever should always be carried at about three-fourths cut-off when the engine is drifting, as this will allow the engine to drift more freely and there will be less smoke and gas sucked into the cylinder.

Q. Describe the course taken by the steam from the time it leaves the boiler until it is exhausted from the stack, when starting and when working compound?

A. Ordinarily, when starting without the separate exhaust valve being open, steam, upon opening the throttle, passes from the throttle standpipe to the dry pipe and to the steam pipes leading to the high pressure steam chests, thence, as the high pressure valves open and close the steam ports, it passes to the high pressure cylinder and is exhausted into the receiver, from which, by the movement of the low pressure valves, it is admitted to, and exhausted from, the low pressure cylinder, the exhaust passing out through the exhaust nozzle the same as in an ordinary locomotive. At the same time, when starting, live steam is admitted to the low pressure steam chest through the reducing valve, this steam taking the same course into and out of the low pressure cylinder as the receiver steam, or exhaust from the high-pressure cylinder. After the engine has made a few revolutions the exhaust steam from the high pressure cylinder will bank up in the receiver, causing the reducing valve to close, and thereafter the engine will work compound, the steam taking the same course as before, with the exception of the live steam passing through the reducing valve. If the engine is started with the separate exhaust valve open, however, the exhaust from the high pressure cylinder, instead of banking up in the receiver, is exhausted direct to the exhaust nozzle through the separate exhaust valve, the steam used in the low pressure cylinder and admitted through the reducing valve taking the same course as before.

Q. How are the simple and compound features controlled in Mallet engine?

A. In the Baldwin type, by means of an emergency valve in the cab, which, when opened, allows high pressure steam to flow direct from the boiler into the receiver and from the receiver into the low pressure cylinders. In the American type, by means of an intercepting valve and an emergency valve. When the emergency valve is opened it throws the intercepting valve in such a position as to allow high pressure steam to flow from the high pressure steam chests direct into the receiver pipe, and from thence to the low pressure cylinders.

Q. Should the high pressure engine become disabled, how would you get the locomotive in?

A. By opening the emergency valve in the cab, so as to allow high pressure steam to flow to the low pressure engine.

Q. Under what conditions should the emergency or starting valve be used?

A. Only when starting, and to prevent stalling on a heavy grade.

Q. What are the duties of the intercepting valve?

A. To supply steam to the low pressure cylinders when starting, and to cut off the supply when the reservoir pressure has reached the desired abount.

Railway Training School.

The Railway Commercial Training Schools of Elmira, N. Y., under the supervision of Superintendent Utley, is doing splendid work in preparing young men and young women to fill the position of telegraph operator and station agent. The schools located in the Snyder Building, are equipped with model railway tracks, signals, switches and all the track appliances used in the operation of an ordinary railway. The pupils receive instruction in all details of operating and besides that are taught stenography, typewriting and when necessary handwriting. Particular attention is devoted to the practice of clear, legible handwriting of the character that trainmen can read readily when used in writing orders.

These schools are doing valuable services for railway companies as it supplies them with men and women able to perform the duties of station agent and telegraph operator without long and tedious experience of the actual work. The pupils are drawn mostly from country villages and are invariably of excellent character and intellectually bright, so that they readily absorb the details of the practical work that station agents and others are required to perform. For a fairly educated young man or woman who has not learned any other business, we consider the Railway Commercial School of Elmira, N. Y., offers an excellent opening for a permanent career. We understand that there are always more applicants for graduates of this school than there are scholars who have completed the course.

Terriffic Automobile Speed.

In his Motoring Notes to the Glasgow *Herald* of which he is a regular contributor, our Glasgow agent, Mr. A. F. Sinclair, gives particulars of a speed test of automobiles which exceeds any vehicular velocity that we ever heard about. A 25 horse power Talbot car, weighing about 2,500 pounds, having four cylinders, was run for half a mile at a velocity of 113.29 miles an hour. Longer stretches were made at from 109 to 111 miles an hour.

We do not mention this with the idea that some of our railway officials will key up their locomotives to attain a speed of two miles a minute, but we think that train speeds are now too great. We merely wish to mention that reckless automobile running is not confined to the American Continent.

Track Work on the Pennsylvania.

The new grade elimination work of the Pennsylvania Railroad extending over ten miles of track from Linden, N. J., through Elizabeth and on to Colonia, N. J., is probably the largest track elevation work now in progress in the east. It is interesting to note that all of the concrete bridges, arches, and tunnels are being carefully and thoroughly waterproofed by a most modern method, having five layers of Hydrex felt cemented together with Hydrex hot compound.

Questions Answered

INEQUALITIES IN FLANGE GEAR.

228. H. P. A., Central Aguirre, Porto Rico, writes: We have an engine here that shows excessive flange wear on the right side. The engine runs the same way all the time, as we have no facilities for turning round. We run backwards on the outward run, and, of course, come ahead on the inward run. I attributed the trouble to this fact, but a leading official here pointed out that there are a number of curves, their variety and number being about equal both ways. What do you think is the cause of the peculiarity? A.—There are a number of causes that produce flange wear on one side. Among these are inequalities in the springs and spring hangers, misplaced truck centers, that is, the center casting on the locomotive may not be exactly central. If the truck wheels on the tender also show more wear on the right side, the defect is not likely on the locomotive, but should be looked for on some particular part of the track. The curves may be apparently equal, but the elevation of the outer rail may not be exactly adapted to the speed of the locomotive at all points.

SCALE IN BOILER.

229. W. W. T., Grand Rapids, Mich., asks: Will you kindly explain why a locomotive boiler containing large quantities of mud and scale will use more water than a clean boiler will? This seems to be the case whether the engine is in operation or not. It is taken for granted that there are no leaks anywhere in the boiler. A.—The assumption is a mistaken one. A certain quantity of water will evaporate a certain quantity of steam under any condition. It will require much more fuel to overcome the non-conducting sediment between the fuel and the water and consequently the steaming qualities of the locomotive will be much impaired, but the exact ratio of water to steam will be maintained. It may be added that steam at atmospheric pressure fills 1,644 times the space occupied by water. At a pressure of 150 pressure per square inch the steam is only 173 times the volume of the water. This law is absolutely unvarying.

ENLARGED STEAM PORT.

230. J. M. C., Delmar, Pa., writes: Can you tell why the steam port of the valve chamber of a Walschaerts valve gear of a class H 6B Pennsylvania Railroad standard locomotive is one-eighth of an inch larger on the back end than it is on the forward end of a piston valve? This is the admission port. A.—This is done in order to make up for the decreasd area of the piston on the side occupied by the piston rod. In adjusting the Stephenson valve gear it is customary with some expert valve setters to arrange the points of cut-off, so that a larger allowance of piston travel occurs on the back or piston rod side before the steam is shut off. On the Walschaerts valve gearing this variation could not be accomplished without affecting the opening or lead at the end of the stroke. Hence the enlargement of the port is the only means available to increase the supply of steam to make up for the back of piston area referred to.

CRANK'S ANGULARITY.

231. R. M. B., Newark, N. J., writes: I am familiar with the expression "angularity of the crank," but I don't know what it means. Will you kindly explain? A.—If you measure the center of the cross-head to the center of the axle of an engine having a main rod 5 feet long and 24 inches piston stroke and then measure to a line perpendicular to the center of the axle you will find that the length of the main rod comes about 1¼ in. short of reaching the perpendicular line. The angle formed between the center of the crank, the perpendicular line and the point that comes short of that line is the angularity of the crank. The effect of the crank's angularity is to make the piston fall behind on the forward stroke and reach ahead on the backward stroke.

DEFECTIVE E. T. BRAKE.

232. J. B., Marshalltown, Ia., writes: The E. T. brake on an engine acts in the following manner, with both valve handles in running position, the brake appears to be all right but as soon as either brake valve handle is moved away from running position, a heavy blow of air starts from the exhaust port of the automatic brake valve and continues for some little time after the handles are returned; all air pipes are properly connected. Can you tell me what could cause this? A. Yes; but it is quite likely that you already know what caused it or some one asked you this question. As this blow does not occur at a time the release pipe should be open, but does occur when it should be closed by the brake valve rotary, it is evident that something unusual has happened to the brake valve. Indications are that the rotary valve is not off its seat or the blow would show in running position, and a movement of the independent valve causing the blow indicates that the application cylinder pipe is open to the atmosphere at this time.

We have found several cases of this kind caused by the pin in the automatic brake valve handle being sheared off and the handle put on in the reverse position on the key.

DEFECT OF FEED VALVE.

233. J. M., Ft. Wayne, Ind., writes: In case a feed valve fails to keep up pressure or stops up along the road, we are instructed to place the brake valve handle in release position and slack off the adjusting nut of the maximum pump governor top and proceed in this manner to end of the trip or until repairs can be made. If the feed valve of the E. T. brake closes off tight so no air pressure can enter the feed valve pipe, would not the excess pressure top prevent the pumps from running even with the brake valve in release position? A. Not if the brake handle is placed in the proper position, with the handle fully in release position, should the pressure leave the feed valve pipe the blow of air from the warning port would cease and you would then move the handle far enough toward running position to again start the blow, then the rotary valve would be in a position to admit main reservoir pressure to both the brake pipe and feed valve pipe and the excess pressure top could not interfere with the operation of the pump unless from some other defect which might make it necessary to disconnect the operating pipe.

Your instructions on this point however, if they have reference to the E. T. equipment, should be a trifle more explicit.

EXCESS PRESSURE GOVERNOR TOP.

234. J. R. C., Morton, Neb., writes: I do not understand the answer to question number 211 in the October issue. I understand that when the brake valve handle reaches lap position the air pressure is cut off from the excess pressure operating pipe which renders the governor top inoperative. How would the governor top be prevented from stopping the pump if main reservoir pressure remains in the operating pipe? A. When the valve handle reaches lap position, the port j in the rotary valve registers with the grooved extension of port d in the rotary valve seat which then admits main reservoir pressure to the feed valve pipe, hence the excess pressure governor top cannot stop the pump even if main reservoir pressure is not cut off from the operating pipe. This feature causes the pump to start so promptly when the handle is placed in lap position even when the relief port happens to be stopped up.

UNDESIRED QUICK ACTION.

235. J. S. C., Miami, Fla., writes: Can you tell me whether there is any way an engineer can prevent the application of a "dynamiting" triple valve on a passenger train after the brake pipe exhaust is cut off at the brake valve? A. No. The brake pipe exhaust ceases because the brake pipe pressure has entered the brake cylinders, consequently quick action has

taken place before the exhaust at the brake valve has ceased. However, if you have a triple valve that works quick-action upon every service reduction, and have no time in which to locate and cut it out, the best plan in making a station stop is to run up close to the stopping place and while the speed is high, use the brake valve in emergency position which will start the emergency application from the head of the train and there will be no serious shock.

In passenger service you may find that you are making a very slight reduction which may be causing the quick-action to take place, while a somewhat heavier reduction may prevent it, or conversely a heavy reduction may produce quick-action while a series of lighter reductions may, as in the case of a restricted service port, prevent the quick-action. The idea is to note the kind of a reduction that is causing the quick-action to take place, and then avoid making this kind of a reduction until the end of the trip is reached or until the disorder can be located and corrected.

DEFECTIVE BRAKE VALVE.

236. T. J. K., Winona, Minn., writes: If an engineer is out on the road with a locomotive equipped with the E. T. brake, and hauling a freight train, should the upper valve seat gasket of the brake valve blow out between the main reservoir port and chamber "D," can he bring his train in according to the Interstate Commerce law, and how should he do his braking with the least delay to the train? A.—The disorder you mention would prevent the equalizing discharge valve from being lifted to discharge brake pipe pressure, and should this occur along the line of road, there is nothing to prevent the brake from being applied by using the direct application position. This should be done by moving the handle just far enough into emergency position to get a heavy blow from the brake valve, but not far enough to cause quick action and when the brakes are applied, with sufficient force return the handle very slowly to lap position the object being to gradually cut off the exhausting brake pipe pressure.

We do not know that there is any Interstate law to conflict, or that specifies any particular type of brake valve to be used, the defect has merely destroyed the service feature and the brake is still a safety device with an unimpaired efficiency.

FRICTION AND ADHESION.

237. W. G. L., New York City, writes: In a brake application, does not the fact that non-slid wheels stop a train more quickly than slid wheels, disprove the law that friction is the same regardless of surface, that is, the brake shoe offering more surface than the wheel on the rail stops the train in the shorter distance? A.—Not necessarily, it merely proves that the static friction between the wheel and rail is greater than a dynamic friction obtained at this point. If you wish to disprove the law of friction you refer to, all conditions, save the amount of surface in contact, must be equal when the experiment is made.

Care of the Locomotive.

It is a well-known fact that the need for careful maintenance of the locomotive is a growing need, and that many failures are due to fractured frames and rods, loose eccentrics, etc., and that these in many cases could have been avoided had the defects not been covered up with dirt and grease. Much may be learned by those in charge of locomotives in America from the European railways, where the locomotive sheds are kept clean, light and airy, and the engines themselves present a well-cared-for appearance. The railway companies consider it money well spent, and undoubtedly such practice results in ultimate economy, while the enginemen take a greater interest and pride in the locomotives they are employed in handling. The eyes of the railway world are centered on the problem of reducing the time locomotives are out of service from various causes, or in other words, the time elapsing between the arrival of the engines at terminal stations, and that at which they are ready for service again. Much depends on the quick despatching of locomotives, and this can only be realized in its best form where there is co-operation between all of those who are concerned with the working of the engines, from the chief of the running department downwards.

Hardening Soft Iron

To harden soft iron wet it with water and scatter over its surface powdered yellow prussiate of potash. Then heat to a cherry red heat, which causes the potash to melt and coat the surface of the soft iron. Then immerse quickly in cold water and repeat the operation. A white heat must not be used, as this would not harden but oxidize the iron. Care must be used not to use red prussiate of potash instead of the yellow. It will not answer.

How to Clean Tools.

To keep tools clean and bright, rub a little mercurial ointment over them, which will form a moisture resisting coating. Mercurial ointment is also known as blue butter. It is somewhat poisonous.

Another good mixture to keep tools from rusting is made by taking six parts of lard and one part of rosin. Heat these together slowly till the rosin is all melted. The mixture is then taken out into the open air for fear of fire, and benzine added in about the proportion of one pint of benzine to half a pint of lard-rosin mixture. When cool, the mixture can be rubbed lightly over the bright steel articles. Tools thus treated will resist the corrosive action of even salt water.

Keeping Metals from Rusting.

To keep metals from rusting rub them off perfectly clean and paint them over with the following mixture: Dissolve half an ounce of camphor in a pound of lard, or in that proportion, according to the quantity used, and before it cools enough to be hard, mix in enough black lead to give the whole the color of iron. This should be well and thoroughly applied all over the metal, being careful not to omit any spots, and let it remain over night. The next day rub off clean with rags. If kept dry by the weather, metal treated in this way will keep perfectly free from rust all winter. Olmstead's varnish is made by melting two ounces of resin in one pound of fresh, sweet lard, melting the resin first and then adding the lard, and then mixing thoroughly. This is applied to the metal, which should be warm, if possible, and perfectly cleaned, and afterward rubbed off. This has been well proved and tested for many years, and it is all that it has been recommended to be. It is particularly well suited for iron surfaces which a slight rust is apt to injure very seriously.

Railroad Men Wanted.

The Interstate Commerce Commission is in need of men with railroad experience for positions both at the office of the Commission and in the field. Appointments are made as a result of examinations conducted by the Civil Service Commission throughout the country. Theoretically there are three hundred examination places, but actually, at every examination held to date, no candidates have appeared except at barely a score of places. As a result the positions are practically going a-begging, mainly, it is thought, because the Civil Service Commission has no authorized method of advertising to reach railroad men especially.

The entrance salaries of these positions range from $1,200 to $3,000, with later promotions to even higher salaries, and it is believed that these salaries are sufficiently large to appeal to the railroad clerks and agents of the country if they could be reached with information concerning the examinations. The Civil Service Commission gives the announcements of examinations. Interested persons should write the Civil Service Commission for its form No. 376 and fill out and return to the Commission, when full particulars will be given in regard to vacancies and dates of examination.

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Give the Boiler Tube Its Due.

We have recently received questions from several European correspondents who wanted to know the effect on the economical operation of locomotives of the huge grate area for which American locomotives are noted. Experience has taught us that the extremely large grate area, used on many American locomotives, is the cause of waste of heat and we believe that the fashion of specifying unusually large grate area was based upon a mistake.

A long time ago we began hearing the assertion made and repeated, that one foot of firebox surface was worth five or six feet of tube surface and the statement was never contradicted or explained with justice to the tube surface. The effect of magnifying the value of firebox surface and making odious comparisons of that with tube area, was to make many men responsible for the designing of locomotives conclude, that the larger the firebox in comparison to the tube surface, the greater would be the economy in the combustion of fuel. There is some truth in the assertion that the firebox area is more efficient than the tube surface; but it is the presence of the tubes that makes the firebox of value and it would not require the enlarging of the firebox surface to be pursued very far before we would have a merely furnace boiler. Moreover, the firebox surface owes its high efficiency to the fact that its sheets receive the first heat from the products of combustion, and that they pass into the tubes robbed of a considerable portion of their original heat. It is impracticable to expose this whole of the heating surface of a boiler to the same high temperature and every attempt to effect uniformity in this respect has ended in failure. Some engineers who believed in giving the tubes their full duty as evaporation surface, have introduced fireboxes with surfaces covered by non-conducting material, but such attempts were uniform failures. To make an ideal locomotive boiler firebox and tube surface must harmonize. It must be borne in mind that every foot of surface added to the firebox not only does less work than that done by a foot in the smaller area, but also reduces the latter by reducing the temperature of the fire and that of the tubes by reducing the temperature at which the gases leave the firebox. Although the firebox surface has the advantage of receiving heat both by radiation from the fire and by connection from the gases, the latter action is in a roomy firebox, so much less effective than that of the tubes, that the tube surface may, under certain circumstances, be fully as efficient as the firebox surface. If the influence of speed is considered it follows that in some instances when the velocity of the gases is just right, the evaporation in the flues will exceed that of the firebox, and there is reason to believe that this is frequently the case in practice.

The tendency towards huge grate area, which follows the demand for large fireboxes, has the effect of depressing the temperatures of the firebox and permitting part of the fuel gases to pass away below the igniting temperature. We have never found reason to believe that Daniel K. Clark made a mistake when he asserted, as a result of his experience and experiments, that the smaller the grate area consistent with proper admission of oil, the greater would be the boiler's efficiency. Not a few American railways have found it promoted economy of combustion to put dead plates in the grates of engines having huge fire areas.

Steam engineering provides many examples of boilers that are efficient obsorbers of heat with little or no part of the surface exposed to radiant heat from the fuel. The absence of surface, which would abstract heat directly from the fuel, also tends to more perfect combustion by reason of the higher temperature attained and it is in accordance with the dictum of an eminent authority that "so long as chemical reaction is taking place, all that tends to cool any portion of the gas should be avoided." The more perfect combustion and the readiness with which the gases leaving the firebox at a high temperature subsequently part with their heat, appear fully to compensate for the absence of transmission by direct radiation. Our plea is to give the tubes due credit for their efficiency, remembering that it was the tubes that made the locomotive boiler its great success in providing railways with a high speed engine.

Giving Information About Accidents.

Changes in official sentiment concerning railway accidents and publicity relating to the same have been very pronounced during the last decade. It used to be the practice for all the officials likely to receive accurate information concerning accidents to deny point blank that any unusual occurrence had happened, even when newspapers had announced accidents to important trains or many people were on the anxious seat for the safety of their friends or relations.

The regular practice nowadays is for the officials of roads, when accidents have happened, to give full particulars to persons who may be interested. The change is very proper and is likely to prevent much unnecessary sentiment against railroad companies. Accidents to trains are inevitable and it does not help the matter to pretend that nothing unusual has happened, in fact, attempts at suppression of information has generally resulted in exaggerated reports of what were sometimes minor accidents. The new policy is assurably an improvement on past practices.

The Metric System.

We notice in the public prints a growing tendency to call for the introduction into the United States of the International Metric System of Weights and Measures. The English speaking countries have resisted steadily the introduction of the French system of weights and measures, but it seems to us that circumstances are pushing the practical men of all countries adhering to the old systems to fall into line with the metric system. The manufacture of electric appliances is exerting strong influence in favor of a universal system of measurements, especially as articles made for foreign markets must be made to conform to the measurements of the countries where they are going. Russia and Montenegro are the only countries in Europe besides Britain that do not use the metric system.

Making Conventions Valuable.

We have several times commented upon the ambition of the executive committees of our mechanical associations, which moves them to name a large variety of subjects for report and discussion at conventions. Anything that is worth doing is worth doing well; and the attempts to touch upon more subjects than the time at the disposal of a convention permits to be thoroughly discussed, is a mistake that results in loss of the valuable facts that discussions never fail to bring forth.

Thoughts on this subject have been suggested by reading the report of the committees on the subjects to be reported upon and discussed at the 1913 convention of the International Railway General Foremen's Association. There are only four subjects specified, and they are all of a character that will bear profound investigation and wide-reaching discussion. The advantage of thorough discussion is that it brings out the information possessed by the individual members and is much more comprehensive than any report prepared by the chairman of a committee. The International Railway General Foremen's Association has been peculiarly strong in the discussion of reports. The members are in close touch with details of all shop subjects, they are men who thoroughly understand their business and most of them have acquired sufficient facility in public speaking to enable them to express themselves fluently and intelligibly. We have just devoted three hours to examining discussions in the last three reports and the experience has been most edifying. To any of our readers who wish to keep well informed on shop matters we would say, read carefully the reports and discussions of the eight annual reports of the International Railway General Foremen's Association and you will acquire more useful knowledge concerning shop matters than you can glean from any other line of reading that we are acquainted with.

An important part of the engineering knowledge brought to light through the labors of all the mechanical associations is lost because its effect is too transient. Reports are read and discussed and parts of these are printed, but the impressions made are not sufficiently lasting to be of permanent value. To read and study these vehicles of useful information in the retirement of your homes is the proper way to obtain full advantage of the work performed.

The personal experience enjoyed by the members who attend the conventions is very valuable, since it enables them to make comparisons of their work with that of others. In that respect men are stimulated to do as well as the best, but details are soon forgotten unless the memory is helped by reading occasionally particulars of the ideas exchanged. Touching this view of convention work President Pickard in his last inaugural address remarked: "I have been a strong advocate of convention work since early in my career and appreciate the amount of good it has done to myself personally and in connection with the General Foremen's Association. We are able to talk to our many associates on various matters and be entertained on problems that we may have taken years to understand, the results being beneficial to yourselves and to your neighbors."

Washing Out Locomotive Boilers.

At the recent meeting of the International Railway Congress the subject of washing out boilers was discussed at some length. The discussion that it had been proved that washing out with hot water not only reduces the time a locomotive has to stand idle but also its cost of maintenance. The system is superior to that of using cold water, but neither method suffices for removing hard scale which is deposited on the tubes and other inaccessible parts of the boiler. On the other hand, the materials which later on form hard scale are suspended in the water, and when the boiler is generating steam briskly they collect chiefly at the surface. That is why the timely removal of this scale-forming matter, as and when it separates from the water, prevents hard and thick incrusations from being formed in the water, seeing that the water proper will then remain nearly always clean. Of all the methods known, a high temperature is the best for separating from the water any solid substances dissolved in it. As those substances are generally very light, they rise to the surface of the water and are kept there by the bubbles of steam which escape.

Government Ownership of Public Utilities.

A great many people believe that a national government can do things better than individuals, companies or corporations, but the reverse is the case. There is some sentiment in favor of legislation to put the Government of the United States operating the railroads of the country and other public utilities, but the experience that other countries have gone through in managing railways indicates that it would be a sad day for public convenience when railroad operating began to be managed by government officials. Not a few countries have tried the experiment of operating railways and it is a mere truism to tell that they are the worst operated railways in the world.

On this subject the editor of the New York *American* gave an answer to a correspondent who is in favor of government ownership of railroads that seems to cover the whole subject.

In the course of his reply Mr. Forbes says, in answer to the assertion that freight and passenger rates will be reduced under government control, that "the United States Government is the worst managed organization in the whole land. There is not even a pretense of a budget. It wallows along from year to year, neck deep in financial mire, knowing little of where it will land. A set of books is a farce."

The idea that anyone should think it will do better in running the railroads of the country than it does in the management of the business already in hand, is a huge mistake. But on the other hand, the statement is made by Mr. Forbes, that "government is a necessary evil and the less a nation has of it the better. Government is a voluntary giving up of freedom on the part of the governed."

That was the idea on which Thomas Jefferson based his political doctrines and rallied behind him such a following as to make him the boss in American politics for a generation. But it is a totally mistaken one. Government is not a necessary evil. It is an invaluable good. It is the only condition on which civilization itself is possible.

The individual left to himself falls into a dozen ways of evil as long as every man does that which is right in his own eyes. No fact in all history is more familiar. Government is the very highest good, then, that is possible to humanity. Bad as it is in most cases, it is still so much better than no government that there is no basis of comparison between them.

Let the contrary doctrine be taught, that government is indispensable to order and progress, and the taxpayer will see that taxes wisely spent are the best possible investment that he can make. Government ownership is breaking down the world over. Public operation of public utilities is a failure at least nine times in ten. In fact, there is no illustration of it anywhere on a scale larger than that of a moderate municipality, that can be justly called a success after a ten years' trial.

Conference of Firemen and Managers.

The claims of the locomotive firemen of fifty-two Eastern railroads for adjustment of pay and improved conditions of work are now being pushed before the general conference representing the railroad companies in the same manner that the claims of the locomotive engineers were urged several months ago. Elisha Lee, vice-president of the Pennsylvania Railroad has taken the place of chairman of the railroad conference committee in place of J. C. Stuart, vice-president of the Erie, who presided at the engineers' conference.

The firemen's demands are voiced by J. S. Carter, president of the Firemen and Enginemen's Brotherhood. The claims of the firemen were drawn up

at a meeting held in Chicago, which was attended by the leaders of the firemen. The principal demands are:

For general passenger service, $2.70 a day on engines weighing 100 tons or over; $2.60 a day on engines weighing 70 tons or over, but less than 100 tons; $2.50 on engines weighing less than 70 tons, all exclusive of tender. For general through freight service $4 a day is asked for engines weighing 120 tons or over; $3.25 on engines weighing 90 tons and less than 120 tons; $3 on engines weighing 60 tons and less than 90 tons, and $2.85 on engines weighing less than 60 tons, all exclusive of tender. The wages demanded for hostlers are $2.50 and $3.75 a day, according to service. Ten hours, 100 miles or less are to be looked on as a day's work.

The firemen contend for a ten-hour day and insist that firemen held at other than their home terminals must be paid continuous time for all time they are so held after the expiration of fifteen hours from the time they have registered off duty. The firemen also insist that they be relieved from all hostler or round house work, which consists of the cleaning of engines, tanks, fires and flues, scouring of brass, painting of stacks, smoke arches and front ends.

Savings and Success.

Saving is said to be a lost art, but no one has ever found a satisfactory substitute for it. No benefit certificate can ever take the place of a savings bank account. Protection and savings are both alike necessary; no one can safely neglect either of them.

Sir Thomas Lipton, the great British merchant and yachtsman, who, by his own unaided efforts, rose from poverty to wealth, recently said:

"When men tell you there are no more chances in this world, tell them they are mistaken. America abounds in so many that I marvel why anyone cares to leave its shores. There are thousands of manufacturers that are still in an imperfect state; there are millions of acres that are still to be made productive; there are countless achievements yet to be undertaken.

"I have often been asked to define the true secret of success. It is thrift in all its phases and, principally, thrift applied to saving. A young man may have many friends, but he will find none so steadfast, so constant, so ready to respond to his wants, so capable of pushing him ahead, as a little leather-covered book with the name of a bank on its cover. Saving is the first great principle of all successes. It creates independence, it gives a young man standing, it fills him with vigor, it stimulates him with the proper energy; in fact, it brings to him the best part of any success—happiness and contentment. If it were possible to inject the quality of saving into every boy, we would have a great many more real men."

A Tribute to James Watt.

The greatness of James Watt, both as thinker and practical engineer, is not always fully recognized, and it is pleasant to find Sir Charles Parsons paying a generous tribute to his memory. Sir Charles said the invention of James Watt was the chief cause of the success of the *Fulton* and also of the *Comet* where others had failed, for the invention meant a reduction, in one step, of more than 6 to 1 in coal consumption over any previous engine. For years Watt had been interested in steam navigation, but too much engaged with his pumping engine to spare time for the application to marine purposes of his great invention of the separate condenser. In 1770 he appeared to have had clearly in his mind the screw propeller. The laws of steam which he discovered were simply that the latent heat was nearly constant for different pressures within the ranges used in steam engines, and that consequently the greater the range of expansion the greater would be the work obtained from a given amount of steam or coal. He also showed that the expansive force of the steam continued down to the vacuum in the condenser. Watt had formed a clear idea as to the advantages to be derived from the compounding of two or more cylinders in series, but in his day materials and workmanship did not admit of high pressures, and its realization remained in abeyance until engineering and metallurgy had so far advanced that boilers suitable for high pressures could be constructed. The adoption of higher pressures came gradually, spurred on chiefly in the attempts at road locomotion, and later by the introduction of the railway locomotive.

Would Put Railways Into Hands of Politicians.

The train accidents which have happened lately on the New York, New Haven & Hartford Railroad have excited intense furore among the politicians and are made the excuse for working up new restrictions upon railroads generally. Representative Victor L. Berger, the Socialist member of Congress from Wisconsin, is particularly fierce and has proposed a resolution asking the House to instruct the Secretary of Commerce and Labor to ascertain and report the actual value of the railroad's property, the estimate to be used as a basis for its acquirement.

In explaining his resolution, Mr. Berger declared there would be "a general and justified outcry" if a country highway were operated in the interests of a few and in such a way as to constitute "a constant menace to the persons who travel on it." He denounced as useless previous Congressional inquiries into alleged railroad abuses, on the ground that the investigations "had no particular end in view," and defended his proposal, although it involved the question of government ownership.

It is likely that the prevailing storm will blow over and leave no damage done, but it would be a sad day for the American people and for railway employees should the agitation result in putting railroad operation more closely into the hands of politicians.

Fighting Snow.

This is the season of the year when appliances for clearing snow from railway tracks receive the greatest attention from motive power people. It is an exceedingly serious matter for a railway to be buried so deeply in snow that trains cannot be moved, consequently much ingenuity and expense have been devoted to the invention and construction of appliances that could remove snow as expeditiously as possible.

When this line of endeavor first arose inventors supposed that enlarged imitations of the farm plow were likely to prove most efficient, and accordingly double sided push plows were attached to the front of locomotives and such devices are still found efficient on railways where the snow fall is light. On roads where snow was habitually too deep for the pilot plow, huge wedge plows carried on their own tracks came into use and they did and are still doing fairly good service; but they are cumbersome and the manner in which they are used is dangerous.

The writer spent five weeks in the winter of '81-2 on a railroad in Iowa on an engine pushing a huge snow plow which furnished experience that was very common in those days. The first work done was in a cutting about two miles long, which had been filled level with the drifting snow. There were two heavy engines handling the snow plow. Workmen who had been excavating the snow with shovels had cut the front of the snow to a perpendicular fall and it measured over 17 feet. As a preliminary operation we went up near the obstruction. It did not look dreadful when we were at rest, but after examining the scene we went back about three miles to obtain a good run and as we approached the snow bank at a speed of 65 miles an hour, it loomed up with horrible possibilities of disaster Nothing serious happened however. Plow and engines bored into the snow drift giving the sensation one receives from jumping into a fireman's catching sheet. Both engines and plows had to be dug out by shovelers, then we backed and repeated the operation. We "bucked," as they say, into that cutting for six days, when we got through and went on to other places and repeated the operation.

Bucking deep snow with push plows was a slow operation and about the time we were wrestling with snow drifts in Iowa, some inventor conceived the idea of applying steam driven machinery to shoveling snow. From that idea came the rotary snow plow.

In a paper submitted to The Canadian Society of Civil Engineers, in December, Mr. H. H. Vaughan presented a very exhaustive illustrated paper on Rotary Snow Plows, in which he followed up all the steps by which the rotary reached its present efficiency, that enables the machine to cut through snow slides that besides snow have ice, trees, rocks and other obstructions that must be removed.

The rotary snow plow was originally invented in Canada by J. W. Elliott, a dentist of Toronto. It consisted of a wheel having a number of flat arms supported on a shaft rotating in line with the track. This was a very crude apparatus, but it was improved materially by Jull and then all rights in the invention were purchased by Leslie Brothers who put it upon the market.

A working model of the rotary snow plow was exhibited at the Exposition of Railway Appliances held in Chicago in 1883 and attracted favorable attention of railway officials. The first full size rotary snow plow was erected at the Canadian Pacific shops at Parkdale during the winter of 1883-4, and its trial clearly demonstrated that the Elliott principle of a revolving wheel could throw the snow clear of the tracks. Since that time a great many important improvements have been affected on the rotary; but its efficiency demonstrates the soundness of Elliott's idea. All the railroads liable to be snowed under now use the rotary snow plow and it is extensively used in Russia and other countries that suffer from heavy snowfalls.

Parties interested in apparatus suitable for handling heavy snow should apply for a copy of Mr. Vaughan's paper to the Secretary, Canadian Society of Civil Engineers', Montreal, Que. It is likely to be an authority on the subject for some time to come.

Railway Accidents of One Year.

The Twenty-sixth annual report of the Interstate Commerce Commission, which was published last month, is a most depressing revelation for those who have been striving to promote safety in railway operating. The slaughter on railways during the year ending in June last has been greater than ever before in the same time, most of the death and suffering having been the penalty of maintaining high train speed beyond the safe capacity of track and rolling equipment.

The principal causes of train accidents and the resulting fatalities are: Want of proper means for keeping trains from hitting each other; rails too weak for the shocks they receive; rolling stock members unable to successfully resist the strains put upon them; want of proper inspection; carelessness and recklessness of people connected with train operating. The high train speed persistently engaged in accentuates these causes of railway casualties. Railway equipment and safety appliances have been greatly improved during the last three decades, but increase of train speed has more than offset the increase of safety that ought to have resulted.

The most harassing portion of the Interstate Commerce Commission report reads:

"Of the thirty-one derailments investigated, fourteen were either directly or indirectly caused by bad track. In five of these fourteen cases the derailments would probably have been avoided had existing speed restrictions been observed, but in all the remaining cases no adequate speed restrictions were in force, and in three cases the track conditions were so obviously unsafe that derailments were likely to occur even at low speed.

"In one serious derailment an examination of the track in the vicinity of the accident disclosed 906 rotten ties within a distance of 147 rail lengths. Under many of the rails there were as many as eleven bad ties, and under each of two rails there were twelve ties so badly decayed and broken as to be totally unfit for service.

"In many of these ties the spikes were so loose that they were easily removed by hand, the wood having no longer any holding power. The track in the vicinity of this accident was poorly ballasted and was unsafe for the passage of trains at ordinary speed. This derailment occurred on straight track while the train was running about thirty miles an hour."

The report says that "the most disquieting and perplexing feature in the problem of accident prevention is the large proportion of train accidents caused by dereliction of duty by the employees involved. The commission believes that as a rule there are no men that have a keener appreciation of their responsibilities than railroad trainmen and engineers, yet it is pointed out that 63 per cent. of the whole number of accidents investigated were caused by mistakes on the part of employees.

Safety Instructions.

The Pennsylvania Railroad is carrying its safety campaign forward with a commendable degree of earnestness. It has just sent out 50,000 copies of a book of "Don'ts" for employees working on trains, tracks and in shops. These instruction books are printed in Italian and Polish, in addition to English, and are being carefully perused by the employees. The work covers almost every conceivable kind of accident that might occur in railroad work and the "don'ts" are based on the reports of many years of experience. It will be remembered that the Pennsylvania recently received a medal for being the American employer of labor to do most in 1911 for the protection of its employees.

Hand vs. Machine.

Development of machinery has always tended to place human skill in the background, but the people who are thrown out of employment by the introduction of machinery benefit for the reduction of prices that result from the immense increase of production due to the use of machines. Changing from hand to machinery in the production of any article, always throws some people temporarily out of employment, but they soon find work in other lines. People who were employed in hand making operations, such as weaving and spinning have been always poorly paid and the change to watching machinery do the work has always been of benefit to the workers.

Oscillation of the Locomotive

In running a locomotive when the right-hand crank is at 90 degs., and the left at 0 deg., the maximum thrust on the right-hand side tends to swing the front end of the engine to the left, the wheels of the front truck then striking against the left-hand rail when, on the other hand, the right-hand crank is at 180 degs., and the left-hand at 90 degs., the truck will be swung to the right, striking against the right-hand rail. This oscillation of a locomotive is familiar to all, but would not be noticed by most people except at slow speeds, when the engine is exerting its maximum power. The blow delivered in this manner does undoubtedly impart a wave motion to the rail ahead.

A Happy New Year.

There has not been a return of New Year's day for a number of years that is so full of promise as the present occasion. The lingering clouds of financial disturbance, with its incidental industrial causes of unquiet, are passing away and the golden harvest of the vanished year helps to create a better feeling. A growing spirit of greater confidence is seen everywhere. The great arteries of our industrial and commercial life were never so full of the swelling tide of increasing movement. The danger signals are down, the green lights of suspended activity are vanishing, and all the lamps are white. May the hands that grasp the throttle levers of government and finance and industry and education be guided by wisdom and a love of justice and good will towards men, and may we all take up the burden of life with larger hopes and brighter visions and kindlier feelings, and a deeper sense of gratitude for the strength that is given to us to do our share of the world's work!

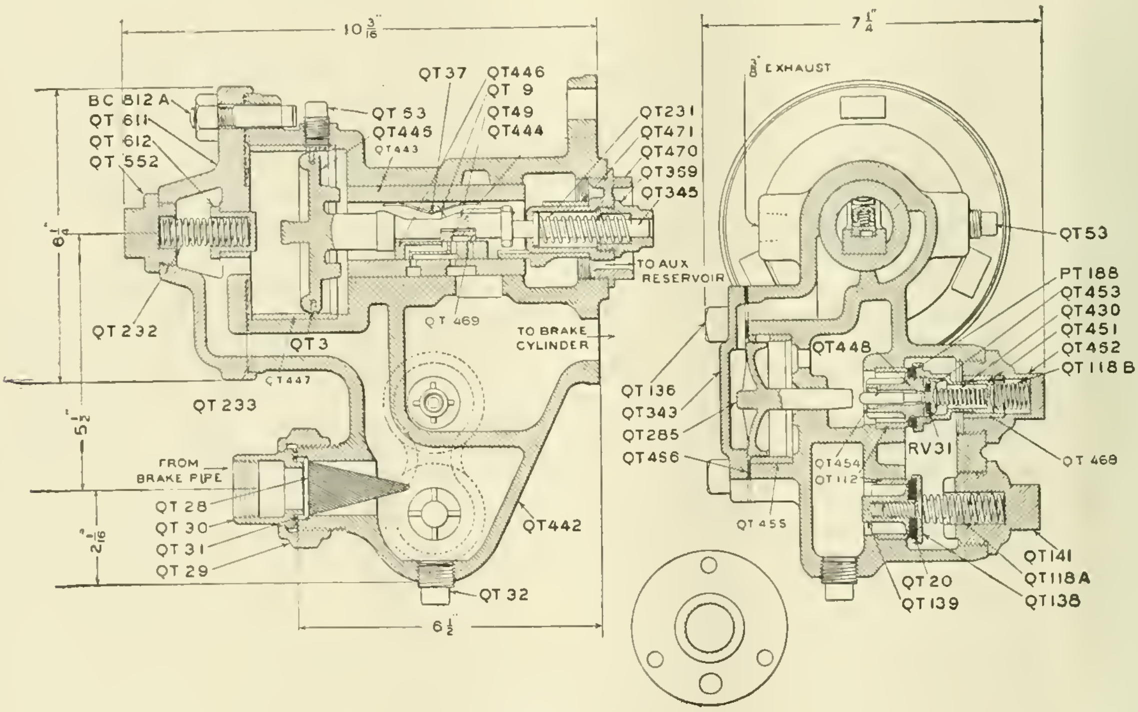
Air Brake Department

New York Triple Valves.

In this issue we have views of the New York Air Brake Co.'s type K triple valves for freight service and the diagrammatic views show several of the positions assumed when in operation.

The feature of the K triple valve is very well known to be, quick service, uniform release and uniform recharge, and the present is the latest New York type. In this valve the quick service port opening is made through the quick action valve and any possible obstruction can be quickly and easily removed.

The feed grooves are circular openings which can be reached by removing a pipe plug from the side of the valve body. The graduating valve is of the slide valve type and operates on the main slide valve. The main piston is neatly fitted in the bushing, and the entire valve shows a good mechanical construction.



K 6 TRIPLE VALVE.

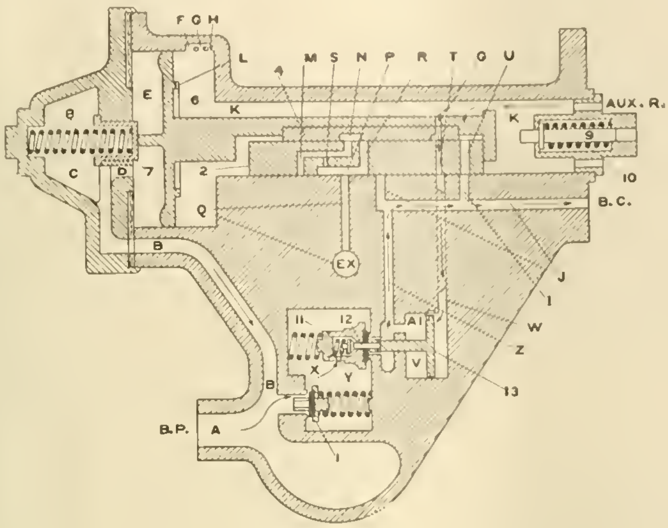
Efficiency of K Triple Valves.

The objective points sought in the development of triples of the K type, and the advantages from their use, are generally recognized, but a genuine appreciation of the wonderful improvements embodied in those valves comes with an understanding of the problems encountered in attempting to operate all the air brakes on a long train of cars. The air brake operation, when six or seven cars are coupled up, is simple and harmonious, but all railorad men realize to some extent, that applying the brakes and releasing them on 80 or 100 cars is a somewhat different proposition. It is plainly apparent that the problem lies in applying and releasing every individual brake of the 80 or 100 as perfectly and uniformly as done on 6 or 7 cars, and the most prominent factors that tend to prevent, and have prevented the harmonious action of the greater number of brakes, or rather the principal difference in the results attained and those desired, are due to increase in the volume of free air to be compressed, increase in the volume of compressed air to be expanded, and an increase in pipe friction or resistance to the flow of compressed air, consequently an increased or additional length of time in which to apply and release brakes is required.

It is therefore obvious that the time element is the chief consideration, and if an engine with the usual main reservoir capacity is coupled to the modern long train, it will require over 30 seconds time from the movement of the brake valve handle for main reservoir pressure to flow to the rear car on the train.

It requires this amount of time to force compressed air through the long empty brake pipe. During a service reduction of brake pipe pressure on a 100 car train, about 30 seconds after the brake valve movement, the brake pipe pressure on the first car will have fallen about 15 lbs. while the pressure on the last car will have dropped but about 2 or 3 lbs. This unequal fall of pressure cannot be overcome by any enlargement of brake valve exhaust ports, as it has been attempted and a peculiar phase of the situation is, that the fall in pressure is even slower on the middle cars than those on the rear. This is due to the flow of air from the rear cars tending to supply the amount that is flowing toward the brake valve. The slow fall in pressure of course, tends to prevent the application of brakes, but another very serious problem is encountered when the brake valve handle is placed in release position, because the first brake is released within about 5 seconds of the movement of the brake valve, while the last brake cannot be released within 45 seconds, even under the most favorable conditions as to air pump and main reservoir capacity, and if the train is to be brought down a heavy

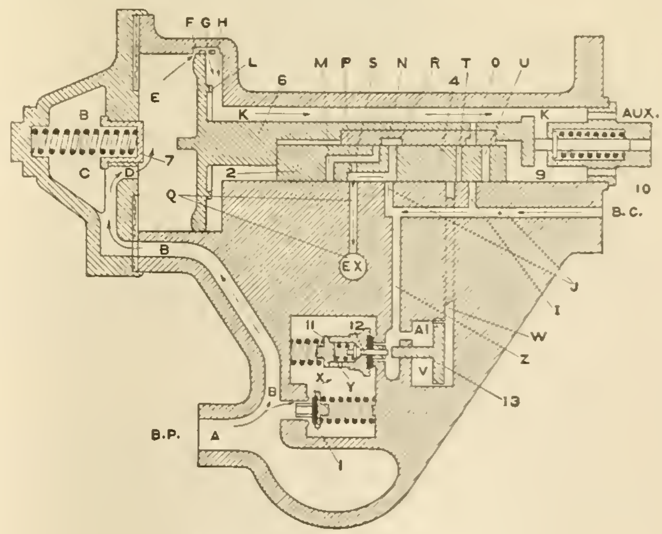
grade that will require numerous applications of the brake, the only brakes that will be doing any work worthy of mention after the first heavy application, will be the head brakes, as they are recharged and re-applied before the rear ones can be sufficiently charged to develop enough braking power to be of any consideration. This is readily comprehended if we understand that a vast difference in pressure can exist in the two ends of a long brake pipe. Coupled to an uncharged train and with a movement of the brake valve to release position it is possible to maintain 70 or 80 lbs. pressure in the brake pipe on the first cars for a sufficient length of time to charge the auxiliaries to this figure while the 100th car, 70 or 90 seconds later may have less than 20 lbs. pressure. Further than this, it is possible to overcharge the head end of a long train to such an extent that when a subsequent application in service position is attempted, quick action will occur. While this is a result of improper manipulation of the brake valve, it may be taken as a rough outline of the principal difficulties encountered in the operation of air brakes on long freight trains when type H triple valves are in use.



SERVICE.

Some very undesirable effects have been overcome by the introduction of the type K triple valve, but it was recognized that any additions or improvements must be confined to a degree that will insure harmonious operation with equipments already in use, and the type K triple valves are interchangeable with, and contain all the features of the H triples and in addition, features known as Quick Service, Uniform Release, and Uniform Recharge.

The quick service feature hastens the time of brake application in service in the same manner that the quick action feature hastens the application in emergencies, but in a somewhat milder manner, but just as efficiently, as the time of application is reduced one-half, while the emergency remains the same in both valves. This reduced time is brought about by each K triple valve making a reduction in brake pipe pressure on each car as it moves to service position, this local reduction assisting to operate the next triple valve, whether H or K type, and the brake pipe air thus absorbed by the type K valve is conducted to the brake cylinder, and is in volume about equal to the displacement of the brake piston which leaves the auxiliary pressure to add to the cylinder volume and force the piston beyond the leakage groove and promptly build up a brake cylinder pressure. Due to this serial reduction, a 5 lb. reduction of brake pipe pressure with K valves results in an application of every brake in a long train, the 100th brake as perfectly as the first, with a substantial increase in brake cylinder pressure over that obtained by a 5 lb. reduction on H triple valves. The uniform release feature retards the escape of brake cylinder pressure on the head cars of the train during the release of brakes and for a sufficient length of time to permit brake pipe pressure to raise high enough on the rear cars to release their brakes, which cannot be forced to a restricted release position, due to the length of brake pipe between them and the brake valve; thus the rear brakes releasing freely while the head brakes' release is retarded results in the release of all brakes being practically uniform. In this connection it may be stated that under ordinary circumstances a gage attached back of the thirtieth car in a train, during a release, will show such a slow rise in pressure that an observer cannot tell whether the brake valve handle is in release or running position, that is, the rise in pressure in the middle of the train is not any faster with the valve handle in release than when it is in running position. The uniform recharge feature consists of restricting the feed groove capacity of the triple valves when in retarded release position so that an overcharge is prevented while brake pipe pressure is high at the head end of the train, but further than this the slower recharge at the head end compensates for the difference in time required to raise brake pipe pressure on the rear cars so that the higher brake pipe pressure charging through a smaller groove is equal to the lower brake pipe pressure at the rear end charging through a larger groove, and all reservoirs reach their maximum pressure at about the same time.

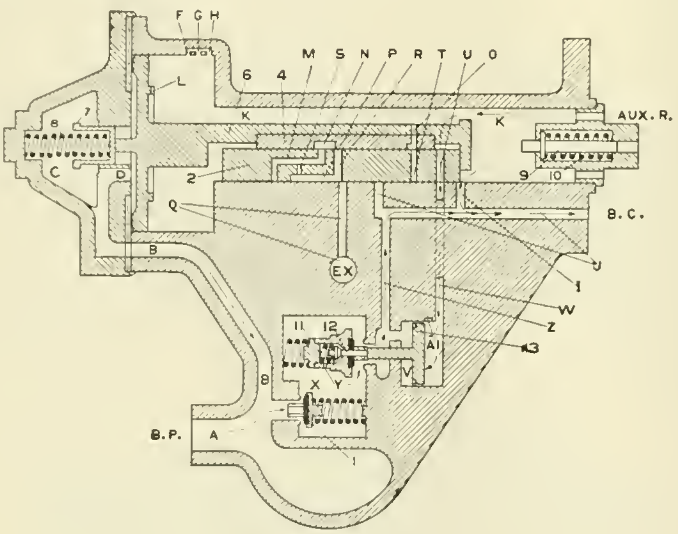


NORMAL RELEASE AND RECHARGING.

This feature, which permits the auxiliaries at the head end to absorb less brake pipe pressure than would be possible with wide open feed grooves, makes it easier to secure the prompt rise in pressure on the rear end, which makes more positive the release of all brakes in a train. A large number of break-in-twos occur as a result of an attempt to start a train with the rear brakes still applied,

and in the measure that the uniform recharge insures the release of brakes it guards against their remaining applied on the rear end, while at the same time the uniform release retarding the escape of brake cylinder pressure from the head cars, until the rear car brakes have started to release, makes it difficult to start any portion of the train until all the wheels can revolve, and furthermore, the combined features obviate the necessity of coming to a stop at low speeds before releasing brakes. During air brake tests it has been determined that the improvements embodied in type K triple valves make possible some very desirable results in train braking operations, as with these valves more tonnage can be handled on descending grades or with the same tonnage a very much greater factor of safety is provided. The quick service feature insures the application of every brake that can be applied with a service reduction and the effect

formity of application and release tends to reduce the effects of unequal braking power, and variation in piston travel and less compressed air is required to operate K triple valves, consequently less steam will be used from the locomotive boiler. The combined features of these valves are particularly adapted to grade work, as a positive application of all brakes in service and a uniform recharge give a more uniform wheel temperature throughout the train, and, of course, wheel temperature is taken to represent braking effect and the results of overheated car wheels need not be dwelt upon at this time. Such matters as the adoption of something new in brake equipment does not appeal very forcibly to the private car line or the small railroad, but the advantages of the features added to the K triple valves do receive the attention of all the air brake men of the larger systems, with the result that in a few years time the standard type of quick



EMERGENCY.

of a 5 lb. reduction in brake pipe pressure is about equal to the effect of a 15 lb. reduction with H triple valves, which leaves a higher auxiliary reservoir pressure with K valves, which is of importance in grade work, as, if all other conditions are equal, the K valves will have a braking power in reserve that can be used in cases of emergency.

The maximum tonnage that can be handled on a grade is governed by the size or number of air pumps used, with K triples, but the same cannot be claimed for other types of valves, as the time required to recharge depleted reservoirs must be considered, therefore a greater available braking power is at hand at all times and trains can be stopped in shorter distances.

It is also possible to make several applications in the same length of time that will be required for one application and recharge with old style valves, and uniaction triple valve will disappear. This is assured by the fact that for a very small sum of money the worn out type H triple valve can be restandardized and converted into a type K valve.

Air Brake Subjects.

We have always made a special effort to keep the air brake department of this magazine as nearly to date as circumstances and our ability in this direction would permit. During the past 18 months we have described and illustrated the "P. C." equipment for passenger cars and have summarized the problems encountered in freight train braking, and followed this up with a description of the "Empty and Load" brake for freight cars.

Those of our readers who may have been content with the mere reading of the articles will do well to keep those copies of Railway and Locomotive Engineering for a future reference.

This opinion is based upon the sales of these brake equipments and the success they have met with in service. Let no one imagine that these equipments are the results of Mr. Turners' excellent air brake ideas, but unnecessary because railroads have been operating without this type of brake, because the empty and load brake will become the standard brake for all cars of large carrying capacity. In fact the writer is of the opinion that even if the railroads would refuse to meet the additional expense of equipping their large capacity cars with an efficient brake, the Interstate Commerce Commission would take steps to enact legislation that would prevent the interchange of cars with an inferior brake for its loaded weight when an efficient brake is on the market, therefore we would advise our air brake readers to keep in touch with the development of the empty and load brake because it will require as much, and more intelligent care as the standard brake.

As this department is conducted solely for the purpose of assisting railroad air brake repairmen, inspectors and firemen in their daily duties, a very personal reference may be excused.

The writer, realizing that he was a trifle slow in making an analysis or recognizing the wherefore when a new brake was about to be placed on the market, always made it a point to get all the information possible on the operation of the particular brake before the company he happened to be working for could purchase and install any of the equipment, and it was sometimes necessary to travel a considerable distance to get the information, but by the time the new brake did arrive he knew, in a general way at least, how the brake worked and what it was intended for. We have never had any occasion to regret this and assure our air brake friends that time spent in this direction will never be wasted as a great many railroads are willing and anxious to remunerate intelligent service.

As to the "P. C." equipment, it is not merely a sublime conception of an ideal and efficient brake for passenger cars, but in connection with the clasp type of foundaiton brake gear is the only practical solution of the braking problem for heavy passenger cars. A reserved and unimpaired emergency brake available at any time during and after service applications double braking power for emergency stops and an emergency application after a predetermined drop in brake pipe pressure is reached may appear quite elaborate for railroad service, but it is the only brake we know of that can bring a modern train of heavy passenger cars

to a stop from a 60 miles per hour speed in 1,200 feet.

Most of our readers will remember that when the high-speed brake failed to bring passenger trains to a stop in reasonable distances, the type L triple valve was developed and the "L. N." temporarily solved the problem, but when another increase in car weight increased the length of the stop, the "L. G. N." triple valve was placed in service, and one more increase in car weight convinced all air brake men that a triple valve was a thing of the past where modern equipment is to be considered, hence the P. C. brake.

Now while the P. C. brake is about all that can be desired from a braking power point of view, the time required to obtain the differential in pressure necessary for operating the brake is about the same for any type of brake, the length of the brake pipe and the volume contained being the principal factors, which are not greatly reduced or increased by any type of brake, thus even the P. C. brake leaves something to be desired.

The time element is eliminated from the brake problem by the "Electro-Pneumatic" brake. This means that the application and release is instantaneously accomplished by an electric current. The brake has been in use in electric service for some time, but is just now coming into use in steam road service.

It is our present intention to describe this brake equipment in future issues.

All the minor obstacles to its installation in steam road service have been overcome and regardless of the equipment the electric attachment is made to, it works in perfect harmony with, but in advance of the pneumatic application and release, briefly stated, if the brake valve handle of the H6 valve is placed in service position, the electric current causes a brake pipe reduction and consequently a brake application before the brake valve equalizing piston can lift to discharge any pressure. Now it naturally follows that if for any reason the electric current should be cut off, the equalizing piston would lift and make the necessary reduction in brake pipe pressure. The release and the emergency application are also electrically accomplished, and in the near future we will describe the "Electro-Pneumatic" brake for steam road service.

There will be a number of articles dealing with the necessity for electric transmission, and at the present time do not positively know just which brake will be described, as an absolutely new brake of the electro pneumatic type is about perfected and now undergoing a test in railroad service.

This brake has not as yet been named, but it is a universal equipment, one size of apparatus for any class of steam or electric service, for any type of car or number of cylinders used. This is mentioned to inform our readers that the air brake subject has not yet been exhausted, and during 1913 an interesting air brake department is expected.

Drifting of Superheater Locomotives.

It is desirable to have a certain amount of steam used in the cylinders of superheater locomotives when they are drifting and instructions are in effect on several roads that the steam must not be shut off entirely under these conditions. J. E. Osmer, master mechanic of the Chicago & North Western, has developed a device which is used on the West Iowa division to call the engineer's attention to the fact that the steam has been shut off entirely while the locomotive is drifting. This is accomplished by tapping a small pipe into a back cylinder head on one side of the locomotive, to which is attached a small check valve seated against the steam pressure in the cylinder. A small pipe extends to the cab, at the end of which a double disc tin whistle is applied. When steam is used in the cylinder the check is seated, but if it is shut off while in motion, which is contrary to instructions, a vacuum is created in the pipe, unseating the check valve and drawing air through the disc whistle. The engineer immediately opens the throttle far enough to break the vacuum in the cylinder. This amount of steam will aid greatly in lubricating the valves and cylinder packing, consequently reducing the wear on them. Another means of bringing about the same result is as follows: A T connection, where the old pipe, tapped into the center of the cylinder, connects to the lubricator, contains an upward seated valve. This is held against its seat when steam is worked, but if a vacuum is created it will sound a disc whistle. In this particular construction there is no check valve between the lubricator and the cylinder. Both of these devices have worked out successfully.

Vegetable with an Ancient Lineage.

Asparagus is the aristocrat of the food plants. None other has so distinguished a lineage, for its records reach back almost to the beginning of authentic history. It is mentioned by the comic poet, Cratinus, who died about 425 B. C. The Romans held asparagus in the highest esteem, the elder Cato treating at length, in his "De re Rustica," still extant, of the virtues and correct cultivation of the plant. Pliny, writing about 60 A. D., has a great deal to say of asparagus. He says: "Of all the products of your garden your chief care should be asparagus."

Handwriting and Spelling.

We hear a great deal of talk these days about methods of improving the education of the young, but in our opinion the best thing that the friends of sound education can do is to return to the good old fashioned system of properly grounding scholars on what used to be known as the three R's. Perhaps the prevailing use of the typewriter is to blame, but the melancholy fact is true that the majority of graduates of our public schools appear to have had no proper instruction in handwriting and few of them can spell a dozen words in succession properly.

We have admiration for the boasting of a Missouri teacher named Jones, who made public the claim:

"I am the greatest speller, not of Missouri, not of the United States, but of the whole world! Now, I confess that sounds a trifle egotistical, but, you must remember, I don't claim to be an engineering expert, or a preacher or a doctor, but I can spell, and what's the harm telling the truth? You see I've made it a specialty. Forty-three years ago I began teaching a district school in Wapello county, Ia., and we had spelling matches. I noticed that it was a good thing for the students to learn to spell; it made 'em quick and observant, and they got along faster with their other studies. It became a sort of hobby with me, and, finally, while teaching at Olathe, Kan., in 1870, I threw down the spelling gage to whomsoever cared to lift it. The dean of the university there, a man ripe in years and learning, took it up, and we two went at it."

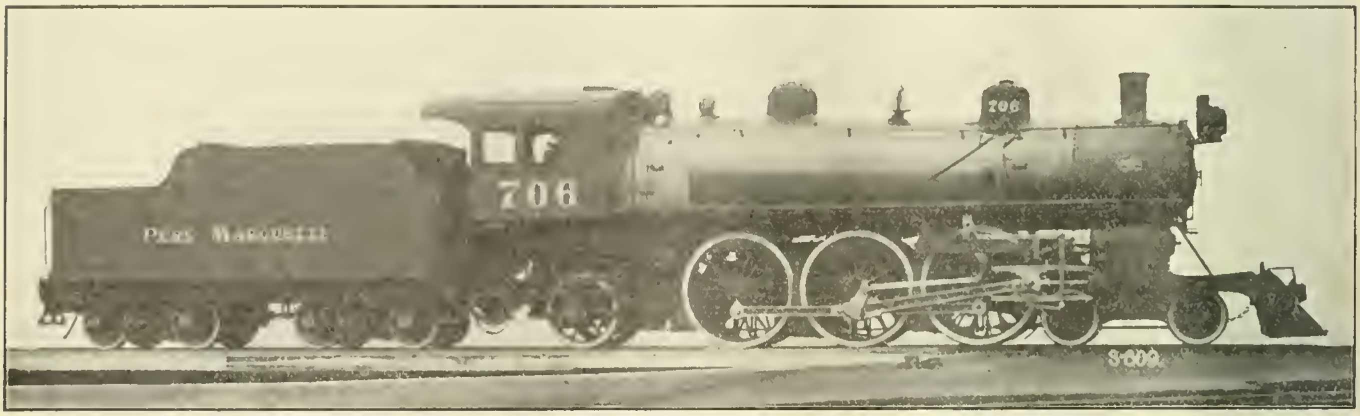
The district school teacher beat the dean of the university. After that nothing could stop him. Every succeeding fall he issued his challenge. Now and then it was accepted, but after one defeat followed another in the attempt to lift the championship from him they quit, the professor says. It is said that a young lady, a proofreader on a newspaper, once bested the professor in a famous spelling match.

Among the items of New Year's news is one to the effect that the Pullman Car Company has decided to increase the wages of its clerks from 6 to 12 per cent. Nothing is said about car porters, but we suppose that class of employees will look for an increase on the 25-cent tip that has become time honored.

Railroads are not the only interests to suffer from special legislation. A bill has been introduced into Congress by Mr. Oldfield, of Arkansas, requiring shoemakers and shoe dealers to stamp upon boots and shoes a list of materials other than leather used in their construction. The measure is being pushed by certain shoe manufacturers.

Pacific and Consolidation Locomotives for the Pere Marquette

In June and July of last year, the Pere Marquette received 25 consolidation and 5 Pacific type locomotives from the American Locomotive Company. The two designs are illustrated herewith. They are equipped with superheaters of the fire-tube type and marked the introduction of the superheater on that road. In the construction of details each is generally representative of the builder's latest practice for locomotives of its particular type. Among the new features presented in the two designs which have been widely introduced on recent locomotives will be noticed the so-called outside steam pipes, self-centering design of valve stem crosshead guide, the self-centering guide for the piston rod extension and the outside bearing radial truck with floating spring seat yoke.



PACIFIC TYPE (4-6-2) LOCOMOTIVE FOR THE PERE MARQUETTE RAILROAD.

The Pacific type locomotives have 22 in. by 28 in. cylinders and a maximum tractive power of 29,900 pounds. The sister engines using saturated steam have 22 in. by 26 in. cylinders and a maximum tractive power of 27,800 pounds. There is also a difference of 6,000 pounds in weight in the two classes of locomotives. The superheater locomotives weigh 220,000 pounds, while the saturated locomotives weigh 214,000 pounds.

The consolidations are much more powerful than any previously used on the Pere Marquette road, and are among the most powerful locomotives of their type constructed by the builders. They carry a working pressure of 180 pounds and have 25 in. by 30 in. cylinders. The maximum tractive power is 50,300 pounds. The use of a low steam pressure has considerably reduced the boiler work as compared with other locomotives on the road carrying 200 pounds pressure.

A saving of 12 per cent. in fuel with 50 per cent. increase in the average train load. These are the results obtained in freight service on the Pere Marquette Railroad with powerful consolidation locomotives of up-to-date design as compared with lighter locomotives of the same class of conventional design, operating in the same territory.

CONSOLIDATION TYPE LOCOMOTIVE (2-8-0) FOR THE PERE MARQUETTE RAILROAD.

Still greater fuel economy has been secured in passenger service by the introduction of moderate weight Pacific type locomotives using highly superheated steam. The superheater locomotives save an average of 22 per cent. in fuel as compared with Pacific type locomotives using saturated steam in the same service. Under severe operating conditions, the new Pacific type of locomotives saved as high as 27 per cent. in fuel. It may be added that, while the consolidations here illustrated have 50 per cent more hauling capacity than the railroad company's lighter class C-2 locomotives used in the same service, they weigh only 33 per cent. more. The Master Mechanic at Grand Rapids, Mich., reports that so far no flues have had to be removed. Neither is there any indication at present that any such repairs will be necessary in the near future. With the locomotives using 200 pounds pressure, part of the flues have to be removed after eight or nine months' service. This is in marked contrast to the records of flue repairs on many of the leading railroads.

The following table shows the principal dimensions of these locomotives:

	280 type	462 type
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Weight on drivers	206,000 lbs.	142,500 lbs.
Weight on truck	23,000 lbs.	41,000 lbs.
Weight on trailers	——	36,500 lbs.
Weight of engine (running order)	229,000 lbs.	220,000 lbs.
Weight of tender (running order)	153,400 lbs.	141,700 lbs.
Wheel base, driving	17 ft. 6 in.	13 ft. 4 in.
Wheel base, total engine	26 ft. 5 in.	33 ft. 10 in
Wheel base, total engine and tender	60 ft. 5¾ in.	63 ft. 3¼ in.
Cylinders, diameter and stroke	25 x 30 in.	22 x 28 in.
Driving wheels, diameter	57. in.	77 in.
Boiler, outside diameter at front end	81-5⁄8 in.	66-3⁄8 in.
Boiler, working pressure per sq. in	180 lbs.	200 lbs.
Firebox, length and width	108 x 75¼	90 x 70¼ in.
Tubes, number and diameter	218-2¼ in.	183-2 in.
Flues, number and diameter	34-5½ in.	24-5⅜ in.
Tubes and flues, length	15 ft. 8½ in.	20 ft. 0 in.
Heating surface, tubes	2655 sq. ft.	2,581 sq. ft.
Heating surface, firebox	185 sq. ft.	152 sq. ft.
Heating surface, total	2840 sq. ft.	2,733 sq. ft.
Superheating surface	550 sq. ft.	557 sq. ft.
Grate area	56.5 sq. ft.	43.9 sq. ft.
Tender, water capacity	8,000 gallons	7,000 gallons.
Tender, coal capacity	14 tons.	14 tons.
Maximum tractive power	50.300 lbs.	29,900 lbs.

Brains in the Workshop.

It is sometimes said that in the modern factory men have been turned into mere machines and labor dehumanized, but the assertion is the exact antithesis of the truth. In the modern factory (says *Engineering*) it is the mental qualities of the employees on which a demand is made, and it is for this reason that the reduction, which has been effected in the working hours usual a century ago, has been reasonable and justifiable. A Chinese sawyer will spend twelve or more hours a day in splitting up by sheer muscle a balk of timber as much as 42 ins. square. Practically no mental effort is demanded from him during 99 per cent. of his working hours. So far as this portion of his work is concerned, he is a mere machine, and an ineffective one at that. His mind may therefore wander to other themes than the matter in hand, whilst his puny strength often fails to move his saw through a stroke of more than 6 or 7 ins. Labor of this kind may well be considered dehumanized, since it makes little demand on qualities other than those possessed by the brute creation. On the other hand, the sawyer in a modern sawmill must keep all his attention riveted on his occupation, since a moment's lapse may lead to irreparable injury to either himself or the work in hand. The whole of his value as a workman is thus dependent upon the possession of certain mental qualities, the exercise of which involves a definite nervous strain. Every year, in fact, sees the introduction of machinery which more and more relieves the workman of duties which can be equally well effected automatically, and increases, on the other hand, the demand on his care and attention.

Lohmannizing.

The protection of iron and steel is at present effected by means of three zinc coating processes: the old "hot galvanizing" process, the "cold galvanizing" process (electrolytic zinc plating), and the "sherardizing" process, says the *Journal of Engineering Chemistry*. The process of "Lohmannizing" invented by H. J. Lohmann, differs from these in that it is not restricted to the application of zinc coatings, but may, it is claimed, be used for coating of zinc, lead, and tin in varying preparations to suit the requirements of each case.

The process of Lohmannizing begins, as usually, with pickling the iron and steel articles in a bath of sulphuric acid. Then the article is dipped into the Lohmann bath, which, being "composed of an acid and an amalgamated salt, further cleanses the pores and cavities, and deposits metallic salt upon the entire surface, penetrating into the most minute pores and cavities." The patent specification states that the Lohmann bath is a solution of hydrochloric acid, mercuric chloride, and ammonium chloride. Next follows drying and then immersion in the molten protective alloy which is at a temperature of 950 to 1,000 deg. Fahr. "An amalgam or chemical union is thus formed between the amalgamating salt and the protective alloy." The temperature of the immersed article rises in contact with the molten alloy, and, when it reaches a temperature of 500 degrees, volatilization of the mercury occurs.

Since the mercury passes from the surface of the alloy, the complete surface is said to be left free and open for the protective alloy to fill its pores and cavities, there being freedom from oxidizing influences. As it is said that it is possible to obtain a perfectly satisfactory lead plating by the Lohmann process, it would seem that the process would be of value in the production of lead-lined apparatus.

Co-operation Better Than Competition.

The time was when the transportation companies engaged in what was known as throat-cutting competition that led many of them into the hands of receivers. Dearly bought experience led most of the railroads to introduce co-operation in place of senseless competition and they have prospered by the change, but we now find that the Federal Commissioner of Corporations in a report recently issued is anxious to have the practice of ruinous rate cutting restored. The New York *Evening Sun*, commenting on the report, expresses our sentiment exactly when it says:

"His report gives statistics showing the country-wide tendency in the United States toward co-operation between rail and water routes. He rather grudgingly concedes that in certain cases railroads have developed water routes to better their service to the public. In general, however, he sees only a desire to eliminate competition in this widespread movement.

"This attitude must strike any shipper with a memory as a very blind point of view. Competition as a means of regulating railroads was tried out very thoroughly in this country. It produced unstable rates, reckless duplication of facilities, poor service, bankruptcy. As a long step in advance we have come to a condition that amounts, generally, to regulated monopoly.

"The case of water routes is not a complete parallel. But their treatment should, at least, be approached with a broad comprehension of past lessons and present facts. What system will give the public the best service, stable and cheap rates, the best developed routes? Is it the rate-cutting, competitive system? Or is it the State regulated service of combined interests working in co-operation with land routes?

"That is the sole question that should be considered. It is greatly to be regretted that the Commissioner of Corporations is conducting his investigation as if there was something sacred about competition and that no possible alternative existed."

No Kid.

There are some enterprising youngsters in Hartford. One of them smoking a cigarette went up to the ticket office and said: "Half return to Boston." "What, a kid like you smoking a cigarette?" said the ticket agent. "Who're you calling a kid?" cried the youngster, "I'm fourteen." "Oh, are you? Full fare please."

Electrical Department

SOUTHERN PACIFIC ELECTRIC LOCOMOTIVE.

Electric Locomotives for the Southern Pacific.

Recently the Southern Pacific ordered fifteen 60-ton electric locomotives to be used for freight and switching service on their electrified lines in California, the first of which has just been completed. They are equipped for operation on both 600 and 1200 volts as were the locomotives for the Piedmont Traction Co. described in our June issue. The mechanical parts were built by the Baldwin Locomotive Works and the electrical apparatus by the Westinghouse Elec. & Mfg. Co.

The capacity of these locomotives is such that a tractive effort of 5,600 lbs. can be exerted continuously with natural ventilation. In order to increase the capacity blowers are provided for forcing air through the motors to cool same and allow for more current to be sent through the motors without overheating them; This increased current means increased tractive effort, and with the forced ventilation the locomotive can exert continuously a tractive effort of 11,520 lbs., double that for natural ventilation. With clean dry rails a momentary tractive effort of 30,000 lbs. can be obtained.

The locomotives are equipped in accordance with trunk line practice. Following are some of the principle dimensions:

Rigid Wheel Base, 7 ft. 4 in.
Total " " 25 ft.
Diam. Driving Wheels 36½.
Distance between Truck Centers, 17 ft. 8 in.
Width, 10 ft.
Length between Couple Knuckles, 35 ft.
Weight, 120,000 lbs.

Each axle is equipped with an independent geared motor. The Westinghouse unit switch control of the H. L. type is used to regulate the current supply to the motors.

Storage Batteries.

Last month we described the various types of plates, both positive and negative, suitable for storage batteries to be used for car lighting.

Another application of the storage battery in railroad work is its use in connection with signals and we will discuss the battery along this line, describing and illustrating the type manufactured by the Electric Storage Battery Co., Philadelphia. Fig. 6 shows one cell of a signal battery resting on a glass tray filled with sand. By the word "cell" we mean a jar which may be of either glass, hard rubber or wood lined with lead, completely equipped with positive and negative plates, filled with electrolyte, with cover, separators and bolt connectors. The glass tray, provided with feet, is for insulating the battery, i. e., prevent leakage of current which would interfere with the successful operation. The dry, fine sand also serves as an insulation, but its prime purpose is to provide a means for a solid support to the glass jar. The sand conforms to all of the irregularities of the bottom of the glass jar and will prevent breakage. Considerable weight is supported on the glass jar and there is considerable difficulty, especially in the large sizes of jars to get a homogeneous glass free from internal strains. In this type of battery only wooden separators are used, and these should not be placed in the cell until everything is ready so that the electrolyte can be added immediately. These wooden separators come packed moist and if allowed to stand for more than a few minutes they will dry out and warp, necessitating the use of new ones.

Fig. 7 shows a complete signal battery assembled on a wooden frame or rack. There are sixteen cells shown giving approximately 32 volts. This complete battery is made up of 16 units or cells as Fig. 6, each cell being connected to the adjoining ones. Space is saved by mounting these cells on two tiers.

The location of a signal battery, as well as any battery, is very important. A separate room is desired which can be well ventilated and kept dry at a moderate temperature. The ventilation should be free, not only to insure dryness, but to prevent chance of an explosion, as the gases given off during charge form an explosive mixture if confined. For this reason an exposed flame should never be brought near the battery when it is gassing.

The success of a storage battery is measured by the care it receives in daily

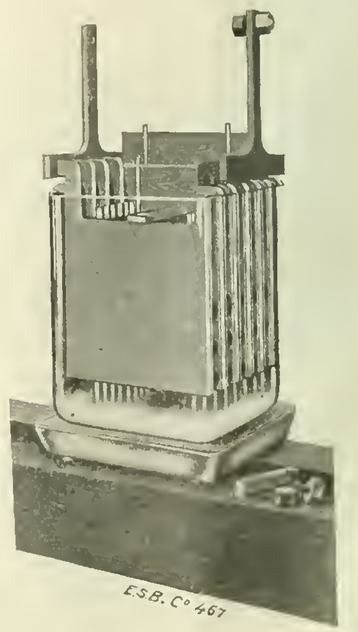


FIG. 6. CELL FOR SIGNAL BATTERY.

operation. The proper amount of charging should be given, and undercharging and excessive overcharging should be avoided. The battery should not be discharged beyond the safe limits or allowed to stand in a completely discharged state as it will be badly damaged.

taken at the surface of the liquid, on the hydrometer, in the glass tube.

The hydrometer illustrated by Fig. 9 is that used for signal batteries and can be placed in the cell itself where it will float at a certain level corresponding to the specific gravity.

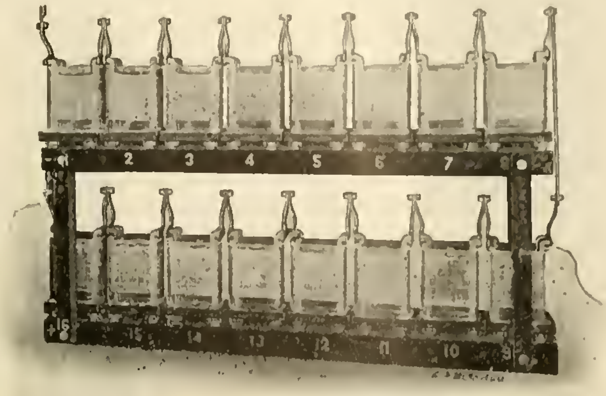


FIG. 7. COMPLETE STORAGE BATTERY.

The amount of charge should be such as to bring the voltage of the battery and the specific gravity of the electrolyte to a maximum, and this charge should not be at too high a rate, i. e., too much current, as the temperature will rise rapidly and soon reach the dangerous point which is 110 degs. F. The temperature should be watched during charge and if this "danger point is reached" it is necessary to reduce the amount of current through the battery.

The safe limit of discharge of the lead batteries is reached when the voltage has dropped to 1.75 volts per cell. In the case of the 16 cell battery, Fig. 7, this voltage would be 28 volts.

The fall and rise in specific gravity of the electrolyte serves as an indication of the amount of power taken out and put into the battery and it varies directly to the ampere-hours or power discharged, and does not vary for different rates, as does the voltage. For this reason whenever practical the fall in specific gravity is to be preferred. The variation of the electrolyte between full charge and complete discharge is 60 to 70 points (.060 to .070 spec. grav.). A fully charged battery with electrolyte at 1.22 will drop to 1.160 to 1.150 at the end of eight hours discharge at the normal rating of the battery.

Special indicators are used for determining this specific gravity, called Hydrometers. Figs. 8 and 9 show the two most common types. The one illustrated by Fig. 8 is that used for car lighting batteries. With the rubber bulb compressed the nozzle is placed below the surface of the electrolyte in the cell to be tested and enough of the liquid is drawn in until the hydrometer, shown within the glass tube, floats. The glass stem of the hydrometer is graduated and a reading can be

Resistance.

The formula in our answer to question 226, page 457, December, 1912, was not correctly stated, although the example was correct. The question was—What is the total resistance of two known resist-

FIG. 8.

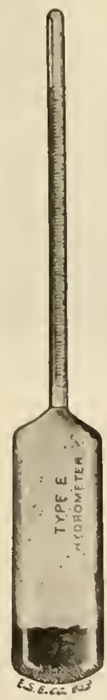


FIG. 9.

ances connected in parallel? A.—The total resistance will be less than either of the single resistances and can be obtained thus:

R (total resistance).

$$R = \frac{1}{\frac{1}{r_1} + \frac{1}{r_2}}.$$ Take, for instance, two resistances of 6 and 8 ohms.

$$R \frac{1}{\frac{1}{6} \times \frac{1}{8}} = 3.43 \text{ ohms.}$$ This same formula holds for any number of resistances in parallel, and in the denominator there should be as many terms as there are resistances in parallel.

Reversing Electric Motor for Planers and Other Machines.

The use of an electric form of drive possesses many advantages over older methods of reversing through clutches or belt shifters. Not only is the usual economy effected in the consumption of power through application of the principle of direct connected individual operation, but maximum cutting speeds are sustained uniformly, acceleration is more rapid on the return travel, and an increased production hitherto unattainable are the results. The reversing motor drive has ushered in new records in machining castings.

The General Electric Company has recently placed on the market a reversing adjustable speed direct connected motor drive that has been carefully tested and tried out in service. Probably the most interesting application of this drive to machine tools at the present time is to planers, viewed both in the light of an engineering achievement and from the standpoint of production. That a very large increase in output does obtain with planers through this means is now firmly established and quite generally understood. But the application of the reversing motor equipment in its various forms is almost unlimited. It is now used not only to drive planers, but also screw, worm and rack driven slotters, turret lathes, wire and tube drawing machinery, and other classes of machines reversed through clutches or shifting belts, which methods are often low in efficiency and high in maintenance. A desirable feature of the General Electric reversing motor drive is that it may be attached readily, wherever electric power is available, to machines already installed and in use, as well as to new machinery.

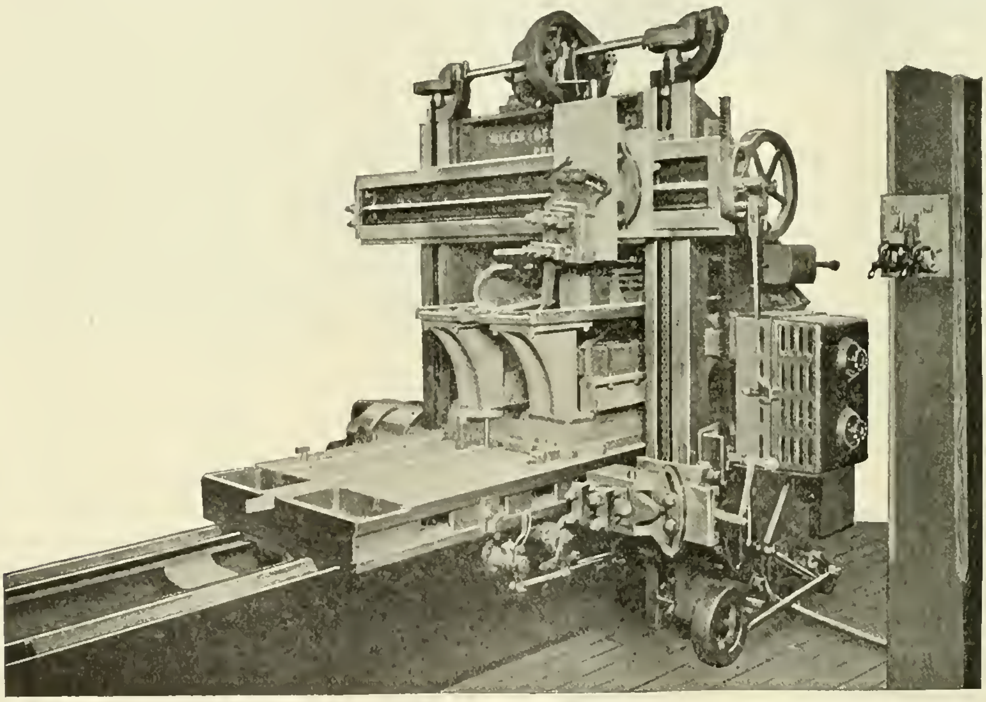
The motors with a speed range of 250 to 1,000 per minute for this service are mounted in any place on the machine or floor convenient for mechanical connection. The master switch is generally mounted on the side of the planer bed, or in other convenient place. The switch is simplicity itself, containing only four contact fingers, two forward and two reverse, one being used in common for both directions, and three segments on the drum, all of liberal proportions. Its sole function is to close the shunt coil circuits of the forward and return line contactors. The motor field is entirely external to the master switch. The panel is encased in a stout cast iron box so arranged that the parts and the wiring are

most accessible. The master switch is operated by dogs on the planer table in much the same way as is now employed for shifting belts. A special double pole C. P. circuit breaker is also supplied, which provides for minimum voltage and overload protection. In case the breaker opens or current fails through any cause, it automatically stops the motor, preventing the platen from coasting off the ways.

By virtue of the commutating pole design of the motor, starting, stopping and reversing are accomplished with sparkless commutation. In order not to break dynamically from high speed in one violent step, means have been taken to accomplish this in three distinct steps, braking down slowly from high speeds and then quickening the brake action at lower speeds. Thus the entire braking is completed in the shortest possible time without undue shock. This feature, in addition to quickening the brake, will be recognized as a decided advantage in the maintenance of the machine. A noteworthy point in connection with the operation of this drive is that the planer table reverses extremely close to a line at the end of the cut. Cutting and return speeds are entirely independent of each other, so that it is possible to use the slowest cutting speed and the highest return speed, or vice versa, in any combination not exceeding four to one, with thirty-five to seventy cutting speeds and the same number of return speeds, depending on the size of the equipment.

It is interesting to note comparatively what has been accomplished with this type of reversing motor drive. As a general proposition, the saving arising from applying power direct to machine tools is considered the amount of friction load which has thus been eliminated. This often reached as much as 50 per cent., yet it is in reality only a small part of what may be realized, as proved by numerous tests. A belt driven planer, or other machine, of approximately 10 h. p. capacity, tunning at a cutting speed of 25 ft., will drop in speed 2½ to 5 ft., or 10 to 20 per cent., while cutting to a value of 10 h. p., if this approach the carrying capacity of the belt, due to size, speed or slackness. If the cutting speed be increased to 50 per cent. with the same depth of cut and feed, the speed will fall while cutting to nearly what it was originally, the power input increasing only slightly or to the limit of the belt capacity. The maximum slip will be reached when the machine is stalled, the power input remaining approximately constant and the loss being entirely due to friction from belt slippage.

Briefly summarized, the salient operating features claimed by the manufacturer for the reversing adjustable speed direct connected motor drive are: Maximum cutting speed sustained uniformly, affording greatly increased production; rapid acceleration on the return stroke; reverses remarkably close to a line at the end of the cut; very economical operation and upkeep; any speed desired within a ratio of four to one; many speed combinations, allowing the slowest cutting and highest return speed to be combined; freedom from shocks, permitting the quickest reversals possible without jar; quiet operation; sparkless commutation, and positive and safe control within easy reach for the operator, the whole forming a safe and serviceable combination.



REVERSING ELECTRIC MOTORS FOR PLANERS AND OTHER MACHINES.

A Train of Electric Locomotives

Recently an interesting sight was the shipment of ten electric locomotives in the same train across the Alleghenies from Philadelphia to East Pittsburgh. These locomotives are the last ten of an order of thirty-nine, for the N. Y., N. H. & H. Railroad, and were shipped to the Westinghouse Electric & Manufacturing Company at East Pittsburgh to be electrically equipped. The mechanical parts were built by the Baldwin Locomotive Works. These locomotives are of the twin-motor articulated type and each is to be equipped with eight Westinghouse single-phase railway motors and unit switch control, as previously described in the August, 1912, issue of Railway and Locomotive Engineering.

Is Proud of the Experience.

The agitation going on about very young children being employed in fruit canning factories and textile establishments reminds us of one who endured similar hardships in childhood and yet emerged in triumph.

Andrew Carnegie working for twenty cents a day is almost as great a strain upon the imagination as that at one time Allegheny, the north side of smoky Pittsburgh, was once the greatest cotton spinning point in the country. But those suggestions do not stagger the ordinary man more than the assertion that one time the regular way of shipping things from Pittsburgh to Philadelphia, Pa., was down the Ohio and Mississippi rivers and thence by water from New Orleans, La., through the Gulf of Mexico and by the Atlantic ocean to Delaware Bay, in a journey of several weeks what is now accomplished in a few hours.

Conservation of Mineral Resources

By A. T. SEWALL

The United States Geological Survey made a report to the National Conservation Commission on how long our mineral resources will last if the present rate of production increases in the future as it has in the past. As railroads and railroad men are vitally interested in the conservation of minerals, briefly epitomized, the situation is as follows: Coal will last 150 years. Natural gas will last 20 years. Petroleum will last 20 years. High grade iron ore will last 25 years. Copper ore reserves will last 10 years, and the end of lead is actually in sight.

Coal will last us 150 years longer, but long before that time the difficulty of mining will cause the price to rise, making it too expensive to burn. There is no question that we are spendthrifts in regard to our resources. It is estimated that in the manufacture of coke we are wasting $38,000,000 per year by the use of poorly devised methods. We are losing millions of dollars per year by not using superheaters in our locomotives and stationary boilers. The latter should have feed water heaters, which save eleven per cent of fuel. The compound locomotive will "come back." When they first came out, a certain road bought one. The general manager had all coal reports sent to his office, and it was plain to be seen that this particular locomotive was saving 20 per cent. in fuel over simple locomotives and her mileage was equally as good. This caused the adoption of compound locomotives, with the result that the compounds would not make the mileage as compared with simple locomotives due to the latter lying in the round house so often for repairs. As the adoption of the compounds was due to the good performance of the first one purchased, an explanation is necessary. The first one was run by an assigned crew; the rest of the compounds were run with pooled crews. If all the engines had been compounds, instead of part compounds and part simples, the result would, in my opinion, have been more favorable.

Of the numerous styles of compounds on the market—good, bad, and indifferent—the best designed one was purchased for the test and its record kept for deciding the advisability of adopting the compound for all new power. In purchasing the later compounds, the worst designed one on the market was purchased.

To a railroad company that desires to save 20 per cent. in fuel, a procedure that will guarantee this result is to get the best designed compound locomotive on the market and have all of them like it. A partial equipment will result in failure. The conservation of coal can be helped by the adoption of a hot water washing plant, where the filling water is heated by the steam blown off from the locomotive to be washed out, thereby saving coal in firing up. It is absolutely a crime to waste steam from exhaust pipes of stationary engines and compressors in railroad shops in summer or winter. In company with a mechanical officer of a trunk line, standing outside of their large locomotive repair shops, I noticed exhaust steam pouring out of an exhaust pipe of a stationary engine. I said to him, "Why waste that steam?" He answered that they had no steam pipes that could utilize the steam. Further inquiry brought out the fact that they were heating one of their shops with stoves. As exhaust steam for heating costs nothing one wonders why it is wasted.

In railroad shops in summer time there is a surplus of exhaust steam that could be utilized in a hot water washing plant. It sometimes happens that a boiler is not blown off but is allowed to cool down, and of course under those circumstances no heat is received from this boiler, water for which has to be heated by live steam. In winter time the demand for heat for buildings and washout plant would be in excess of the supply, but it would be far better to use the exhaust steam as far as it goes than to use it only partially or not at all. The conservation of coal from now on is the most pressing question the railroads have to confront. Too long have they burned coal without considering its economical use.

Petroleum, it is stated, will last for 20 years. What are we going to use for lubricating our locomotives and machinery? There is not enough animal and vegetable oil to lubricate one tenth of the machinery we have now in service. "The present rate of increase in the production of high grade iron ore," says the report, "cannot continue for the next 30 years, and before 1940 the production must have begun to decline and a very large use must be of ores not now classed as available." That is, in 30 years we must resort to ores now classed as unprofitable. The price of iron will become so high as to prevent its use where now largely used, and some other material must be used in its place. Regarding copper, the reserves will last 10 years; some new discoveries are needed if the supply is to keep up. "The end of lead is in sight," says the report. A steady decrease in lead production has taken place since 1903, and this in face of increasing prices. The lead deposits of the world are being heavily drawn upon.

In 150 years what will the state of society be, when all of our useful minerals are exhausted? Someone asked Loed Kelvin how our descendants were to keep warm. He replied they would have to harness the wind, erect a windmill to drive a dynamo and use a storage battery for a reservoir to draw upon when no wind was available. The outlook to me is that the world will become pastoral again. The want of metal will force man to use the tools of the stone age. The horse will come into his own again. Canal systems will be extended, ocean steamers will become sailing vessels. We will have good wagon roads with lines of stage coaches, making 10 miles per hour with relay of horses. Some Pullman of the future will invent stage coaches with berths, so travel will be both night and day. This is no fanciful picture. The age of steam and steel has only existed about 100 years; before that period it is well known how society existed, and to that same stage, unpleasant as it may seem, our descendants are doomed.

Emerson wrote an essay on Compensations. He says, "A certain compensation balances every gift and every defect, very evil its good. For everything you have missed you have gained something else. When we lose our steam engines, factories, telephones, electricity, railroads, and all the other elements of a steam and steel age, it is a comfort to believe there will be a compensation for these losses. People will not be herded in towns, in congested factory districts, but will go back to the land whence we all started. If fuel is not available to keep us warm, we can emigrate to the tropical regions where it is not required. Until that time arrives it behooves each one to make the mineral resources last as long as possible by their economical use, so that our descendants will have kindly feelings toward us as people that conserved their mineral resources as best they could.

Taking It Easy.

It was a very hot day and the fat drummer who wanted the 12:20 train got through the gates at just 12:21. The ensuing handicap was watched with absorbed interest both from the train and the station platform. At its conclusion the breathless and perspiring knight of the road wearily took the back trail, and a vacant-faced "red cap" came out to relieve him of his grip.

"Mister," he inquired, "was you tryin' to ketch that Pennsylvania train?"

"No, my son," replied the patient man. "No, I was merely chasing it out of the yard."

Items of Personal Interest

Mr. R. E. Bell has been appointed master mechanic of the Santa Fe, at Galveston, Tex.

Mr. W. H. McDonald has been appointed roundhouse foreman of the Santa Fe, at Clovis, N. M.

Mr. C. H. Chambers has been appointed road foreman of the engines of the Santa Fe, with office at Dodge City, Kan.

Mr. E. C. Hause has been appointed acting master mechanic of the Georgia & Florida, with office at Douglas, Ga.

Mr. Jacob Helferstay has been appointed general foreman of the Baltimore & Ohio shops at Martinsburg, W. Va.

Mr. D. W. Cross has been appointed master mechanic of the Toledo, St. Louis & Western, with office at Frankfort, Ind.

Mr. W. Cockfield has been appointed locomotive superintendent of the Entre Rios railway, with office at Parana, Argentina.

Mr. H. P. Syfan has been appointed foreman of the Denver & Rio Grande, at Chama, N. M., in place of Mr. J. W McVey.

Mr. A. J. Poole, superintendent of motive power of the Seaboard Air Line, has his authority extended over the Tampa-Northern.

Mr. H. B. Macfarlane, engineer of tests of the Santa Fe, has had his office transferred from Topeka, Kan., to Chicago, Ill.

Mr. John Todd, formerly machine-shop foreman of the Erie, at Galion, O., has been transferred to Marion, O., acting in the same capacity.

Mr. E. I. Mayer has been appointed road foreman of engines of the Northern district of the Chicago & Alton, with office at Bloomington, Ill.

G. E. Perry, master mechanic of the Missouri, Oklahoma & Gulf, has been appointed superintendent of motive power, with headquarters at Muskogee, Okla.

Mr. John Johnson has been appointed roundhouse foreman of the Intercolonial Railway at Sydney, N. S., in place of Mr. D. McClellan, assigned to other duties.

Mr. Hugh Gallagher, formerly road foreman of engines, has been appointed master mechanic of the Santa Fe at La Junta, Colo., succeeding Mr. H. T. Peyton.

Mr. E. C. Moeller has been appointed night roundhouse foreman of the Chicago, Rock Island & Pacific, with headquarters at Burr Oak, Ill., vice Mr. W. O. Morton promoted.

Mr. C. F. Gillaspy has been appointed traveling engineer of the Northern district of the Minneapolis, St. Paul & Sault Ste. Marie, with office at Steven's Point, Wis.

Mr. W. R. Nabile has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific, with headquarters at Winnfield, La., vice Mr. H. P. Arnold, transferred.

Mr. R. B. Brown has been appointed road foreman of engines of the Cincinnati, Hamilton & Dayton, at Indianapolis, Ind., in place of Mr. M. J. Ryan, assigned to other duties.

Mr. J. C. Satterlee has been appointed roundhouse foreman of the St. Louis & San Francisco, with headquarters at Birmingham, Ala., vice Mr. James Galtney, resigned.

Mr. C. E. Stewart has been appointed locomotive foreman of the Grand Trunk Pacific at Biggan, Sask., in place of Mr. G. M. Carruthers, who has been assigned to other duties.

Mr. Thos. E. McQuade has been appointed night roundhouse foreman of the Chicago, Rock Island & Pacific, with headquarters at Peoria, Ill., vice Mr. Lee Munger, resigned.

Mr. W. E. Symons has been appointed superintendent of motive power of the San Antonio & Aransas Pass, with office at San Antonio, Tex., in place of Mr. G. W. Taylor, resigned.

Mr. G. M. Wilson has been appointed general foreman of the Grand Trunk shops at Toronto, Ont., in place of Mr. W. C. Sealey, lately appointed master mechanic at the same place.

Mr. W. D. Johnston has been appointed foreman of the locomotive department of the Chicago, Rock Island & Pacific, with headquarters at Valley Junction, Iowa, vice Mr. J. H. Wills, resigned.

Mr. A. V. Birch has been appointed master mechanic of the Southern district of the Minneapolis, St. Paul & Sault Ste. Marie, and Mr. A. Tillman has been appointed master mechanic of the Northern district.

Mr. G. Mihleisen, assistant general boiler inspector of the Coast Lines of the Atchison, Topeka & Santa Fe, has been appointed boiler foreman, with headquarters at La Junta, Colo., vice Mr. Rance Johnson, transferred.

Mr. H. P. Arnold has been appointed road foreman of equipment of the Louisiana division of the Chicago, Rock Island & Pacific, with headquarters at El Dorado, Ark., in place of Mr. J. E. Mourne, transferred.

Mr. J. Gildea has been appointed locomotive foreman of the Canadian Pacific at Montreal, in place of Mr. J. Wilkinson, and Mr. E. J. Murphy has been appointed assistant foreman on the same road at Toronto, Ont.

Mr. J. A. Burke has been appointed fuel inspector of the Santa Fe, with headquarters at Clovis, N. M. His division extends through what is known as the Pesos division and that part of the plains division south of Amarillo.

Mr. S. E. Crow has been appointed foreman of the Baltimore & Ohio shops at Cameron, W. Va., in place of Mr. P. Hiran, transferred to Vincennes, Ind., as foreman, and Mr. J. J. Smith has been appointed locomotive inspector at the Mt. Clare shops, Baltimore, Md.

Mr. F. Connolly has been appointed supervisor of locomotive operation of the Kansas City Terminal and Kansas divisions, Rock Island Lines, with headquarters at Hampton, Kan. Mr. L. F. Patterson is also appointed to a similar position on the Arkansas division, with headquarters at Little Rock, Ark.

Mr. A. K. Galloway, roundhouse foreman of the Michigan Central at St. Thomas, Ont., has been appointed general foreman Detroit locomotive terminals, Detroit, Mich., and Mr. G. R. Galloway, formerly roundhouse foreman at Montrose, Ont., has been appointed roundhouse foreman at St. Thomas, Ont., in place of Mr. A. K. Galloway, and Mr. P. R. Sands has been appointed roundhouse foreman at Montrose, Ont, in place of Mr. G. R. Galloway.

The Oklahoma division has been placed in charge of Mr. C. S. Yeaton, with headquarters at El Reno, Okla., and the Chicago and Illinois divisions are supervised by Mr. R. E. Wallace. These officials will report to their district master mechanics. They will have charge of the mechanical operation of all engines in service for the purpose of improving economies in the use of fuel, lubricating material, tools, and other supplies, and in the operation of the locomotive. His efforts will also be directed toward reducing the cost of maintenance of locomotives and other operating costs, through improvements that may be brought about by better supervision and instruction of enginemen.

Mr. A. G. Webb, formerly district master mechanic of the Canadian Pacific

at Winnipeg, has been transferred to Souvis, Can., in place of Mr. L. Fisher, who has been appointed master mechanic of district No. 3, office at Brandon, and Mr. P. S. Lindsay, has been appointed master mechanic at Winnipeg, succeeding Mr. Webb. Among other changes are the appointments of Mr. W. H. Walker as roundhouse foreman at Fort William, Ont., and Mr. A. McArthur, formerly locomotive foreman at Fort William, Ont., who has been transferred to Sutherland, Sask., in place of Mr. J. Sindall, who has been made shop foreman at Cranbrook, B. C.

Obituary.

Dugald Drummond.

Mr. Dugald Drummond, late chief mechanical engineer of the London and Southwestern Railway, died last month at the age of seventy-two years. He was a native of Ayrshire, Scotland, and learned engineering in Glasgow. He had a wide experience in the design and construction of locomotive engines, and introduced a number of inventions in connection with the improvement of railway rolling stock. Among others, he introduced the four-cylinder non-compound engine, the inside cylinders driving the leading driving wheels by cranks and the outside cylinders driving the trailing wheels. It was claimed that the loss by condensation on account of dividing the steam into four separate channels was more than made up by a feed water-heating appliance using the exhausted steam to heat the water in the tank. As the water was heated to too high a degree for the ordinary injector, Mr. Drummond adopted steam driven duplex pumps for boiler-feed purposes. Whatever may be thought of his inventive ability, he was unquestionably a high-class locomotive superintendent. The various railroad shops fitted to his designs are among the best in Great Britain. His capacity for work was abnormal. He was a silent, earnest worker, and was highly esteemed in railway circles.

A. Lichtenhein.

The death is announced of Mr. A. Lichtenhein, who was for many years an efficient and popular official of the Galena-Signal Oil Company. The company passed a series of eloquent resolutions expressing their deep regret at the loss sustained by them. He was a noted expert in oils, and his genial and gentlemanly bearing endeared to him many railroad men.

Charles Y. Flanders.

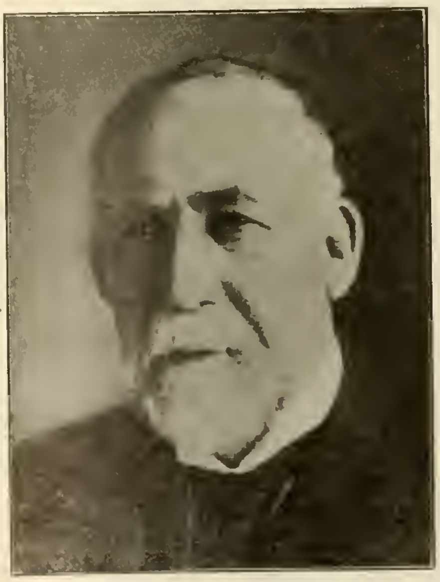
The United States Rubber Company, of Trenton, N. J., announces with profound regret the death of Mr. Charles Y. Flanders, who was for fifteen years prominently identified with the company. Mr. Flanders was very prominent in political and social circles in central New Jersey, and served for some years as mayor of Burlington, N. J. His death is much regretted.

George A. Kimball.

Mr. George Albert Kimball, chief engineer of the Boston Elevated Railway Company, died on December 3, at his home in Arlington, Mass., at the age of 62 years. Mr. Kimball had been identified with much of the recent construction work of the elevated railways in Boston, and was an eminent engineer. The Cambridge subway and elevated extension to Cambridge was designed and the construction supervised by him. He was also the chief designer of the East Boston tunnel.

Alfred P. Boller.

Mr. Alfred Pancoast Boller, formerly chief engineer of the Manhattan Elevated railroad and consulting engineer for the Department of Public Parks of New York, died on December 9, at East Orange, N. J. He was for many years chief engineer of the Hudson River railroad. He received honors from many of the leading engineering societies both in America and Europe.



DUGALD DRUMMOND.

In a letter from Mr. A. J. Rauch, which appears in our Correspondence Department, mention is made of a case in which the engineers of the Philadelphia & Reading condemned Nathan & Dreyfus oil cups through mere prejudice. That was a very common practice in the Good Old Railroad Days, but happily such things very rarely happen nowadays. The cause of the difference is that modern engineers are more progressive than their class of long ago and that appliances intended for locomotive use are thoroughly tested before being put upon engines.

Combination Safety Rally.

The officials and employees of the New York Central, Lake Shore, Pennsylvania, Lackawanna, Lehigh Valley, Wabash, and Toronto, Hamilton & Buffalo Railway Company, met in large numbers in Elmwood Music Hall, Buffalo, on Tuesday evening, December 17, and one of the most interesting and entertaining programmes ever submitted to railway men was carried through to the edification of a large audience. The subject of "Safety First" was the keynote of the meeting, and very interesting and brief addresses were made by Mr. J. G. Rodges, general superintendent of the Pennsylvania; Mr. P. E. Crowley, general manager of the New York Central; Mr. T. E. Clarke, assistant to the president of the Lackawanna; Mr. C. L. Bardo, assistant to the general manager of the Lehigh Valley, and Mr. D. R. MacBain, superintendent of motive power of the Lake Shore. The addresses were interspersed by music from a select orchestra with occasional melodies from a solitary silver cornet.

Short speeches were also delivered by Mr. L. J. Ward, engineman of the New York Central; Mr. T. M. Shannon, engineman of the Pennsylvania; Mr. W. J. Welch, trainman of the Lackawanna; Mr. L. M. Newton, conductor of the Lake Shore, and Mr. J. J. Scott, engineer of the Lehigh Valley. All were eloquent and their remarks were received with much enthusiasm by the audience. Later in the evening Mr. Geo. Bradshaw, general safety agent of the New York Central Lines delivered a special address, which was illustrated by stereopticon views, all tending to impress upon the minds of the audience the necessity for greater safety on railroads. Special trains were run on all the railroads mentioned for the convenience of the employees, and the general opinion was that it was the most instructive and interesting meeting of the kind that has been held on the subject. And the cause of safety has unquestionably been advanced by the interchange of opinion among men who are so eminently qualified by education and experience to speak on the important subject. It is to be hoped that other railroads will follow.

Must be Nearly Done.

A stranger entered a church in the middle of the sermon and seated himself in the back pew. After a while he began to fidget. Leaning over to the white-haired man at his side, evidently an old member of the congregation, he whispered, "How long has he been preaching?" "Thirty or forty years, I think," the old man answered, "I don't know exactly." "I'll stay, then," decided the stranger. "He must be nearly done."

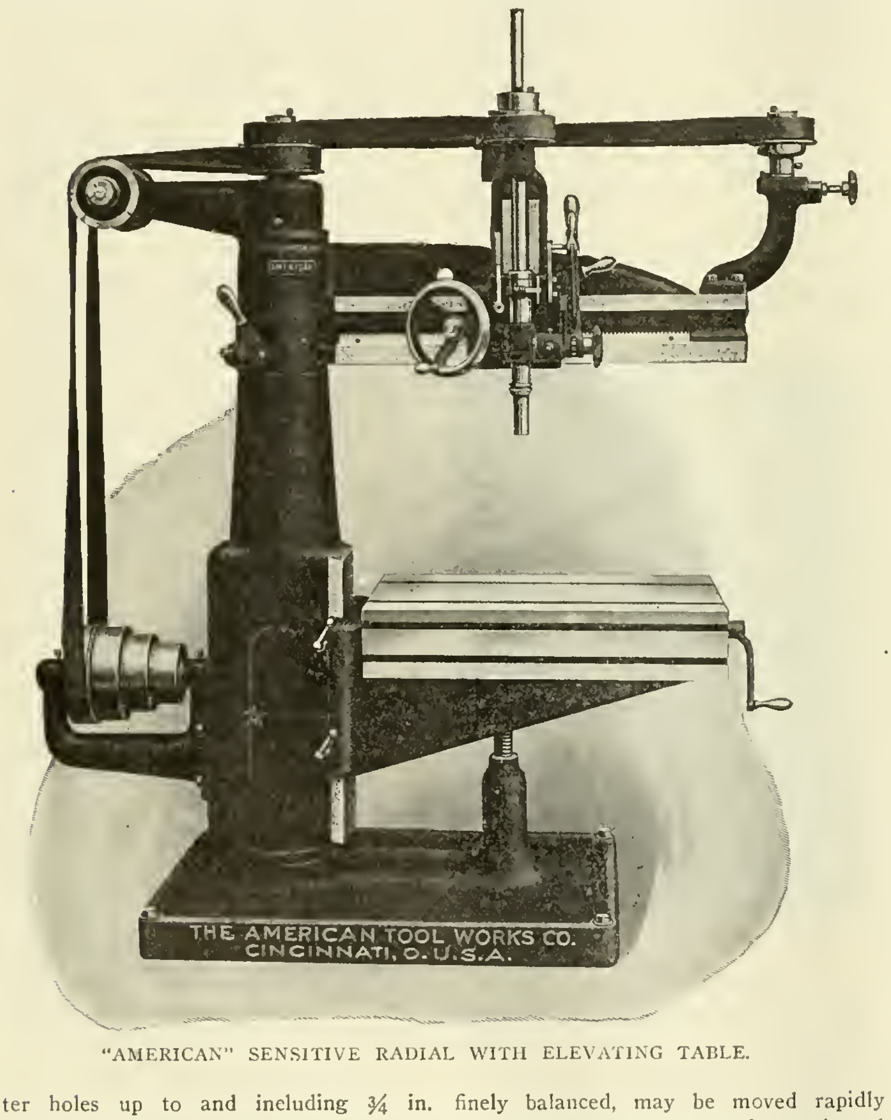
Get away from envy, and you will invisibly get nearer the angels.

American High Speed Sensitive Radials.

A new "American" High Speed Radial Drill has just been perfected and placed upon the market by the American Tool Works Company, Cincinnati, Ohio. It is in many respects the very latest machine of its kind, combining as it does the features that have distinguished the company's fine products with several new additions in mechanism that add to its flexibility and lessen the cost of operation in all the multiplex variety of work of which it is capable. The machine has been designed for the express purpose of rapidly drilling and tapping small diameter holes up to and including ¾ in. diameter, and is finely adapted for work on locomotive and truck frames and all of their attachments.

The machine is constructed in several designs. Our illustration shows the design with elevating table. It is also furnished with stationary table, and also with pedestal base and table omitted. It is also arranged with tapping attachment and moth drive and in these various forms there is no class of work within its range, but can be speedily and perfectly performe on this fine machine.

It will be observed that all levers and operating members are placed most conveniently for the operator, and all possibility of interference with the work to be done is entirely obviated. The ratchet lever feed used on the machine has several notable advantages, among others the fact that when the lever is placed in its vertical position, it is automatically disengaged from the rack pinion shaft, and the spindle can then be adjusted quickly up and down by means of a small star knob on the end of the rack pinion shaft. The ease with which the drill may be brought to or from the work has hitherto not been equalled. The head, which is finely balanced, may be moved rapidly along the arm by means of a rack and pinion operated by a hand wheel. This is located on the left hand side, enabling the operator to swing the extended arm with the right hand while adjusting the head with the left. The sliding head, which moves lightly on a vertical dovetail, readily makes possible a very wide range of work. The head may readily be clamped at any desired point by means of a lever. The rigidity of the machine is perfect, and the manufacturers are prepared to adapt enlargements for special orders that may require enlarged space to accommodate the work. The driving and idler pulleys run in ball bearings and are dust proof. There are six changes of speed, ranging from 300 to 900 revolutions per minute. A depth gauge is attached for special work. No wrenches are at any time required. The machine as shown in the illustration weighs about 8 tons. It is sure to come into popular favor in general railroad and other work.



"AMERICAN" SENSITIVE RADIAL WITH ELEVATING TABLE.

Testing Gauge and Lubricator Glasses.

According to the specification for the glass tubes used in locomotive gauges and lubricators which has just been adopted by the Pennsylvania Railroad, including the lines west of Pittsburgh, all orders are to be in lots of five dozen or multiples thereof, in packages of one dozen, each package containing the manufacturer's name. Each order of five dozen must contain three extra tubes for testing purposes. On receipt of a consignment, three tubes will be taken at random from each lot, for the inspection of the engineer of tests, and they will not be accepted if they fail in any one of the following requirements: If they are 1/32 in. above or below the outside diameter ordered; if the shape is out of truth to a greater extent than 0.01 in.; if they are not straight; if they do not stand the dipping test; if they do not stand the test in the digester; or if they do not stand the hydraulic test. For the dipping test one piece from each lot of five dozen will be heated in valve oil at 350 degs. F. for at least two minutes and as quickly as possible removed and plunged into water at 40 degs. F., this test to be repeated 15 times. In the digester test one piece from each lot will be placed in a digester and subjected to a steam pressure not less than 75 lbs. and not more than 100 lbs. pressure for 72 hours. If at the expiration of this time the tube becomes cloudy, or cracks, or shows any indication of dissolving, it will be sufficient cause for the rejection of the lot. In the hydraulic test one piece from each lot is placed in a suitable holder and subjected to a hydraulic pressure of 1,000 lbs. per sq. in. for one minute. Bursting will be sufficient cause for rejecting the lot.

No Mail for That Animal.

His name was Mike Howe and he was an English agriculturist newly arrived in Manitoba. The first time he called at the village post office for mail he asked in a loud voice, "Have you any letters for Mike Howe?"

The postmaster gazed at the newcomer and growled, "For who?"

"Mikeowe," shouted the farmer. "Have you letters for me."

"No! I haven't," roared the postmaster. "Have no letters for yours or any other man's cow."

RAILROAD NOTES.

The Delaware & Hudson is in the market for 12 consolidation locomotives.

The Erie has ordered 55 steel underframe coaches from the Standard Steel Car Company.

The St. Louis & San Francisco, it is stated, is in the market for 20 10-wheel (4-6-0) locomotives.

The Missouri, Kansas & Texas has ordered 2,000 30-ton box cars from the American Car & Foundry Company.

The Duluth & Iron Range is said to be in the market for a total of 13 Pacific and Mikado type locomotives.

The Norfolk & Western is said to have ordered 4,000 freight car wheels from the Carnegie Steel Company.

The Chicago, Rock Island & Pacific, it is reported, has ordered 1,500 tons of open hearth steel rails from the Pennsylvania Steel Co.

The Chicago & Alton is reported to be in the market for 20 Mikado locomotives, ten six-wheel switchers and ten Pacific locomotives.

The Illinois Central, it is reported, has ordered 25 Pacific locomotives and 30 Mikado locomotives from the American Locomotive Company.

The Canadian Northern, it is stated, has closed for 15,000 tons of steel rails that will be delivered in January. The rails will be rolled at Sault Ste. Marie, Ont.

The Norfolk & Western has ordered 500 box cars from the Mt. Vernon Car & Manufacturing Company, and 500 stock cars from the Ralston Steel Car Company.

The Delaware, Lackawanna & Western R. R., it is reported, has ordered ten Mikado locomotives from the Baldwin Locomotive Works and ten Pacific locomotives from the American Locomotive Company.

The Illinois Central has ordered 2,500 all-steel gondola cars and 500 flat cars from the Bettendorf Axle Company, and is in the market for 1,000 additional gondolas, 500 stock cars, 500 refrigerator cars, 800 furniture cars, 500 fruit cars and 70 cabooses.

It is announced that the Canadian Northern proposes to spend $2,500,000 on new terminals at this plant, including 60 miles of freight yard tracks, extensive repair shops, a 20-stall roundhouse, freight sheds and several auxiliary buildings.

The Norfolk & Western has closed contracts for about 25,000 tons of shapes, plates and bars for delivery during the second and third quarters at Roanoke, Va. This material is to be used for the construction of 3,000 steel cars.

The Harbor Commissioners of Quebec have ordered three six-wheel switching locomotives with 19 x 26-in. cylinders, driving wheels 50 ins. in diameter and a total weight of 120,000 lbs. in working order, from the Montreal Locomotive Works, Ltd.

The Birmingham Southern has ordered two consolidation locomotives from the American Locomotive Company. The dimensions of the cylinders will be 22 in. x 28 in.; the diameter of the driving wheels will be 53 in., and the total weight in working order will be 200,000 lbs.

The Toronto, Hamilton & Buffalo has ordered three six-wheel switching locomotives and 1 Pacific type locomotive from the Montreal Locomotive Works. Two of the switching locomotives will be equipped with superheaters, will have 20 in. x 26 in. cylinders, 51 in. driving wheels, and in working order will weigh 133,000 lbs.

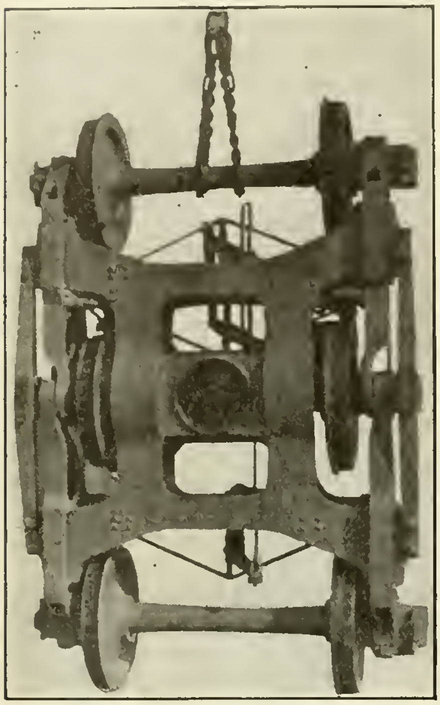
The Erie Railroad has placed an order with the Baldwin Locomotive Works for 30 Mikado type locomotives; another with the Lima Locomotive Works for 5 Pacific type passenger locomotives, and has purchased one special Pacific type passenger locomotive, the 50,000th built by the American Locomotive Company.

The new Koltshugino-Barnaul-Pavlodar line, in the Altai district in southern Siberia, has received the sanction of the Russian government. The new line, which will be constructed by foreign capitalists, is to provide coal for the Altai Railway and those parts of the Altai district which lack fuel because of the absence of forests.

Beginning January 1, 1912, the railways of the Straits Settlements came under the management of the Federated Malay States Government. The terms called for a lease of 21 years at an annual rental of $95,200, subject to septennial revision. It is now proposed to sell the railways to the Federated Malay States Government, and a joint committee is at present considering the question of the price to be paid.

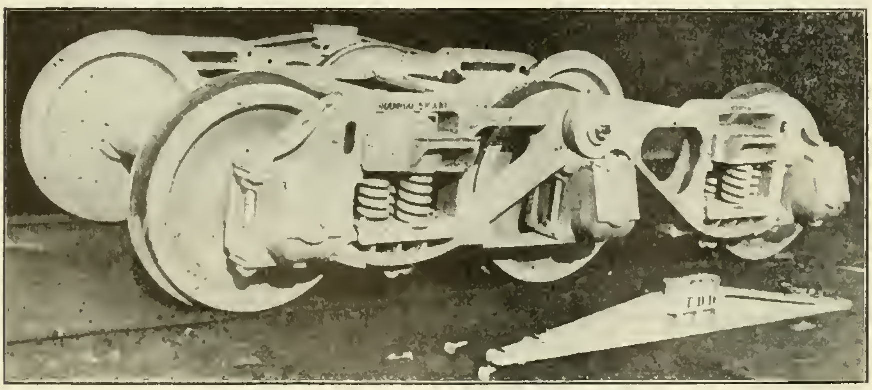
New Six-Wheel Truck.

Among the more important recent devices applicable to rolling stock the "Lewis" six-wheel truck bids fair to take an important place among the mechanical appliances used on railways. The design, as shown in the accompanying illustrations, is intended for the purpose of mounting a heavy freight car without the danger of concentrating too heavy a load on any particular axle. The method unquestionably solves the problem of building a six-wheel truck, perfectly equalized freight car, without the use of pedestals.



TOP VIEW LEWIS SIX-WHEEL TRUCK.

The device is already in operation on the Norfolk and Western Railway, and is used on freight cars weighing 65,000 pounds, and carries 90 tons with the 10 per cent. extra allowance.



SIDE VIEW LEWIS SIX-WHEEL TRUCK.

Patents have been already secured by Mr. W. H. Lewis, the inventor, and Mr. W. H. Melcher, mechanical engineer, both of whom are to be congratulated on the result of their ingenious labors, and we are confident that their work will be quickly appreciated by all interested in the better equipment of the heavy traffic now imposed on railways. The illustrations fully explain themselves.

Twentieth Century Hose Mounting and Dismounting Outfit.

It is gratifying to observe that the Buker and Carr Manufacturing Company, Rochester, N. Y., are meeting with much success in the growing demand for their hose mounting and dismounting outfit. The year which has just past has been the most successful that the enterprising firm has experienced since the introduction of their machine. As we have previously stated, the machine is constructed on scientific principles and operates with a degree of perfection that could not be surpassed.

There is a special equipment for such operation—all work on the same bench and by an ingenious arrangement can be changed as the work requires, as readily as one can change his coat. In mounting, the hose is supported by a tightly fitting clamp box that prevents buckling or injury of any kind to either lining or fibre of any hose mounted thereon. Both nipple and fixture are forced to their place at the same time and by the same motion of the operator. All known kinds of clamps are applied by this outfit and with rapidity. Its mounting capacity is equal to that of six to eight men, and the work is many times nearer absolute safety. As a matter of fact not a single instance has occurred of a "blow-out" with any hose that has passed through the hands of an operator using this machine.

The larger part of the work expected of this outfit can be done under a pressure of 75 lbs., much of it requires but 45 lbs., while in stripping rusty old steam hose 100 lbs. is required—it is obvious that in shops where 150 lbs. pressure is maintained much energy is wasted, unless controlled as above indicated. This outfit requires 2 by 6 feet floor space, weight, crated for shipment, about one-half ton. The manufacturers claim that not one single complaint has yet reached them in regard to the efficacy of the machine.

Proceedings of the International Railway General Foremen's Association.

This volume of 172 pages has reached our desk and it makes an excellent report of the Eighth Annual Convention which was held in Chicago in July last. The careful and painstaking manner in which the volume has been compiled reflects great credit upon Secretary William Hall, of Escanaba, Mich.

Besides the usual official reports, the President's Address and other addresses, the volume contains fine technical reports viz.:

1. How Can Foremen Best Promote Efficiency? by W. G. Reyer.

2. Shop Supervision Under Local Conditions, by W. W. Scott.

3. Shop Specialization Work and Tools, by W. T. Gale.

4. Roundhouse efficiency, by William Hall.

5. Reclaiming of Scrap, by H. C. Voges.

There was also a letter on Driving Boxes, by P. C. Linck.

That is a comparatively small list of subjects for meetings that lasted four days, but they were amply sufficient and gave rise to very exhaustive and prolonged discussions. In fact, we think the discussions of these subjects brought out more useful information than any mechanical discussions we have ever read. An impressive feature of the reports and the discussions thereon was that they were essentially practical, comprising the views of men thoroughly conversant with the subject under investigation.

Subjects for Next General Foremen's Convention.

No. 1—Maintenance of Superheater Locomotive, R. C. Fink, chairman.

No. 2—Engine House Efficiency, Wm. Smith, chairman.

No. 3—Shop Schedules, L. A. North, chairman.

No. 4—Driving Box Work, Geo. H. Hogan, chairman.

Committee on Publicity: W. W. Scott, Elton E. Fay, J. M. Kerwin.

Ampere a Genius.

Of Ampere, whose name is preserved in the vocabulary of electricity, it is told that he taught himself to count with pebbles when he was three years old. Given a biscuit he broke it up into several pieces and found more satisfaction in counting the fragments than in eating them. At the age of 10 or 12 Ampere went to a library and asked for the books of a certain author. The librarian told him, however, that the works were in Latin, a language with which the boy was unfamiliar. He went away disappointed, but turned up again in six weeks' time, announced that he had mastered Latin, and bore away the books in triumph.

Suffragettes Attempt Train Wrecking.

There are many suffragettes in the United States doing their best to win the privilege of voting for our lawmakers. They are sometimes persistent and troublesome in their persuasive ways, but they are always sensible, refined women, who are opposed to violence in every form. The suffragettes of Great Britain appear to be made of inferior material. One of their latest acts indicated that they understand railway appliances.

On Christmas eve, when the milk of human kindness is flowing freely, a party of British suffragettes sneaked into the yards of the Great Northern Railway at London and with ropes tied together the levers operating the interlocking switch signals, rendering them inoperative. By good fortune the dastardly act was discovered by a switch operator and the train collision arranged for miscarried.

The women in several American States have succeeded in obtaining the right to vote; but they did not succeed by train wrecking, arson, assault and battery, window smashing and attempts at murder as the Englishwomen are trying to use as a means of attaining popularity.

Encourage the Imagination.

Constant appeals are being made to the imaginations of children most of them being harmful first or last. Shout to the careless swimmer that he is beyond his depth and cannot possibly reach the shore and the probability is that he will be drowned, when a little encouragement would have strengthened him to gain the beach. The imagination is not to be trifled with. Its wonderful power should be used only for good.

Mysterious Cold Tea.

It was a prohibition country. As soon as the train pulled up, a seedy little man with a covered basket on his arm hurried to the open windows of the smoker and exhibited a quart bottle filled with rich, dark liquid.

"Want to buy some nice cold tea?" he asked, with just the suspicion of a wink.

Two thirsty-looking cattlemen brightened visibly, and each paid a dollar for a bottle.

"Wait until you get outer the station before you take a drink," the little man cautioned them. "I don't wanter get in trouble."

He found three other customers before the train pulled out, in each case repeating his warning.

"You seem to be doing a pretty good business," remarked a man who had watched it all. "But I don't see why you'd run any more risk of getting in trouble if they took a drink before the train started."

"Ye don't, hey? Well, what them bottles had in 'em, pardner, was real cold tea."

Books, Bulletins and Catalogues

Master Mechanics' Proceedings.

The report of the proceedings of the forty-fifth annual convention of the American Railway Master Mechanics' Association held at Atlantic City, N. J., last June has just been published and forms a substantial volume of 432 pages, with numerous plates and illustrations. We presented in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING condensed reports of the work of the various committees immediately after the convention. The volume contains not only the complete reports, accompanied with reproductions of the illustrations used, but also a complete report of the discussions that the reports brought forth. The publication should be of particular interest to all railway men, especially to those engaged in the mechanical department, as it reflects the best thoughts of many of the leading men of our time on many of the most important subjects that confront the intelligent mechanical railway man. The book is finely printed on durable paper and substantially bound. Copies may be had from the secretary, Mr. Jos. W. Taylor, 300 Old Colony Building, Chicago, Ill.

Hydraulic Machinery.

An elegant catalogue, No. 7, is issued by R. D. Wood & Company, 400 Chestnut street, Philadelphia, Pa., containing descriptive matter and illustrations in relation to hydraulic machinery for rubber mills, and other specialties. Among the latter that are of interest to railroad men are high duty pumping engines, gas producer plants for fuel and power purposes, tanks, towers and standpipes, valves for water, gas, either high or low pressure, cast iron pipes of all kinds, fire hydrants, including the "Mathews" standard and high pressure, besides hydraulic operating valves of the three-way and four-way type, and a variety of presses, including their popular steam platen press in a number of forms and sizes. Valuable tables in relation to wrought-iron or steel welded pipe are added, the whole forming a very interesting publication. Copies may be had on application to the company's main office, as above.

American Railway Engineering Association.

The Rail Committee of the American Railway Engineering Association has issued a circular in regard to their experiments with the giant Riohle machine in the Fritz Engineering Laboratory at Lehigh University, which is sure to be received with interest. The present phase of the research is investigating the rate of reduction of the cross section of rails in rolling from the ingot to the finished roll. One hundred pieces of 100 pound American railway association section, two feet long, are being used. As steel mills do not afford special facilities required for this series of tests, the work was taken to Lehigh University, where the 800,000 pound testing machine of Fritz Laboratory—the largest of its type in the world—offers exceptional advantages. Mr. Wickhorst, upon invitation of Prof. McKibben, is to give a talk to the senior students in Lehigh's Civil Engineering Department.

The Twist Drill Calendar.

The Cleveland Twist Drill Company, Cleveland, O., have just issued a new calendar, which is in many ways the most attractive and useful shop calendar yet issued by a tool manufacturing concern. It requires to be seen to be properly appreciated, and while we understand that the edition is limited, the company will gladly send a copy of the calendar, postpaid, to all firms making the request.

Dixon's Silica-Graphite Paint.

The Joseph Dixon Crucible Company, of Jersey City, makes the interesting announcement that the selling price of their Silica-Graphite "One Quality Only" Paint is reduced. They say they make this reduction because the decrease in the price of linseed oil, which is used as the vehicle enables them to do it, and because it is their aim at all times to give their customers any benefit possible in reduction of prices and materials.

This well-known paint which has been the standard for nearly 50 years with leading railroads and manufacturing plants as a maintenance paint, is a perfect, long service protector of all exposed steel and metal surfaces.

Starrett's New Year Letter.

The L. S. Starrett Company, Athol, Mass., have issued a congratulatory circular letter of thanks to their employees which is a model of its kind, and we hope to see the admirable example generally followed. After referring to the marked increase in business during the year the fact is pointed out that "when a man gets over the idea that he is paid for simply putting in so many hours a day and turning out just enough work to get by, and puts intelligent, interested effort into what he does, and even gets a bit enthusiastic over finding a way to improve the quality or increase the amount of his production, his value to the company is largely increased and he is in a way of making much more of a man of himself. We want men, not human machines; not time alone, but brains. A man who is worth twenty dollars a week takes up no more room than one who is hardly worth ten. We are glad to repay increased efficiency by increased wages. We

have made many increases in pay during the year for this reason.

We feel, however, that the increase in efficiency due to intelligent and interested industry in our plant during the past year has been so general and has been such an important factor in the healthy growth of our business, that we may well make some special recognition of it at this time. It was therefore voted by our directors at a meeting held the eleventh instant, to pay, as soon after the first day of January, 1913, as practicable, to each person in the employ of the company on that date, a sum equal to two per cent of the entire amount of wages paid to such employee during the year 1912."

Electric Monorail.

A new departure has been made in the construction of the Electric Monorail System with fixed tongue switch, and is placed on the market by Manning, Maxwell & Moore, 89 Liberty street, New York, in conjunction with the Shaw Electric Crane Co. This is an entirely new departure in Monorail Systems, and all interested should send for a copy of the new twelve-page bulletin which gives full descriptive matter with numerous fine illustrations, including the complete apparatus engaged in a variety of transportation work.

As Ithers See Us.

Out in a far western city there is a considerable colony of Japanese. That these "little brown brothers" are taking our measure may be judged from the following paragraph clipped from a letter written by one Uchida Hirata to a newspaper, says the *Valve World.*

"In United States nobody happy and nobody satisfied. All have too much possibility, nobody attain their ambition Cost of living getting higher, because so many stop producing to quarrel over what is right division of others' productions. Nobody satisfied with his share and pretty soon love of country all gone and government soon break up in many small pieces. Then another strong nation take hold and rule America with iron hand."

When some power doth "the giftie gie us to see oursel's as ithers see us," we get mad or refuse to look. I'm not saying that Jap is right. Far be it from me to think so. But, frankly, brother, doesn't his keen blade just tickle our ribs a bit in the region of our vitals?

Whiskey.

That was a pet saying of Henry Ward Beecher when he declared "Whiskey is a good thing in its place. There is nothing like it for preserving a man when he is dead. If you want to keep a dead man put him in whiskey; if you want to kill a live man put whiskey in him."

Willie Got What He Wanted.

One of the many women who pose as ladies entered a railway car accompanied by a spoiled child and a bright looking nurse maid. The woman prepared to go "nap," the baby prepared to bully the maid and the maid prepared to defend herself. Every time the little villian screamed because he couldn't kick the maid, the mother, with closed eyes, said, "Don't tease the child, Mary; let him have his way!" Suddenly a wasp sailed into the carriage and the boy made a grab at it. "Willie musn't," said the nurse. Willie screamed. "Let the child have what he wants," ordered the sleepy mother. "But, ma'am——" "Let him have it, I tell you!" Willie, thus encouraged, made a splendid capture, and then delighted the other passengers with his scream of agony. "Let him have it, Mary," snapped the lady again. "Ma'am" said Mary, "he's got it."

The Woman Wanted.

A lecturer was touring through the country recently and delivered an address before an audience in a country schoolhouse.

In the course of his remarks he reviewed the agricultural prospects of the country, and as an illustration told a story of a poor farmer who had died, leaving to his wife the farm heavily mortgaged. He said that the widow set to work with a will and succeeded upon one year's wheat crop in paying off the entire mortgage.

When he had completed his lecture, the gentleman shook hands and greeted the members of his audience. One middle-aged man finally approached him thoughtfully and began:

"I say, mister, you told a story 'bout the widow raising a mortgage on one year's crop?"

"Yes, my friend, that was a true story. It happened only two years ago."

"Well, sir, could you tell me who that widow is? She's just the kind of woman I've been looking for all the time."

The Doctor's Fault.

Judge—I am led to understand you stole the watch of the doctor who had just written a prescription for you at the free dispensary. What have you to say to this charge?

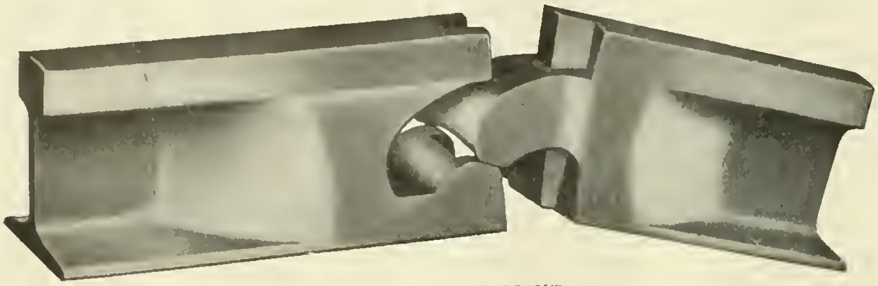
Prisoner—Well, your honor, I found myself in a desperate quandary. His prescription said "a spoonful every hour," and I had no timepiece.

A man's character is the reality of himself. His reputation is the opinion others have formed of him. Character is in him. Reputation is from other people.

Permanent Manufacturers' Exhibit

Railway Supplies and Equipment

Notes of the Exhibits and Reports of Meetings



IMPROVED RAIL JOINT.

Interlocking Rail Joint.

In noting the numerous additions to the Permanent Manufacturers' Exhibit, it is pleasing to note the substantial features of the recent additions. Simplicity in structure and operation is a necessary adjunct in the appliances intended for use on railways, and it is absolutely essential that inventors should have this indulging element in mind when introducing some new device or improvement to the attention of railway men. In this connection it may be stated that the construction of rail joints is an excellent example. The greater the number of parts, the less durable the joint seems to have been, and we are pleased to call special attention to a new departure in this important railway appliance.

The accompanying illustrations show a marked improvement in rail joints. This device was patented by Mr. J. F. Barnhill, secretary and general manager of the International Inter-locking Rail Joint Company, and the joint possesses many points of superiority.

Any new device which is a radical change from the regulation appliance which may be in use is always sure to excite comment, both favorable and unfavorable, and the result is that both lines of argument bring such a device prominently to the notice of the general public. It is a well-known fact that frequently unfavorable comment is productive of much good, as it very often brings to light some organic defect which may have been overlooked, and remedies and improvements naturally suggest themselves to the inventor. In regard to the rail joint illustrated, it may be said briefly that it is the result of many careful experiments, and Mr. Barnhill, the inventor, has submitted the results of his experiments to a number of eminent experts, all of whom agree that the problem of forming a perfect rail joint calculated to meet the growing demands of railway service has been completely solved. It has been tested and retested and improved until the present

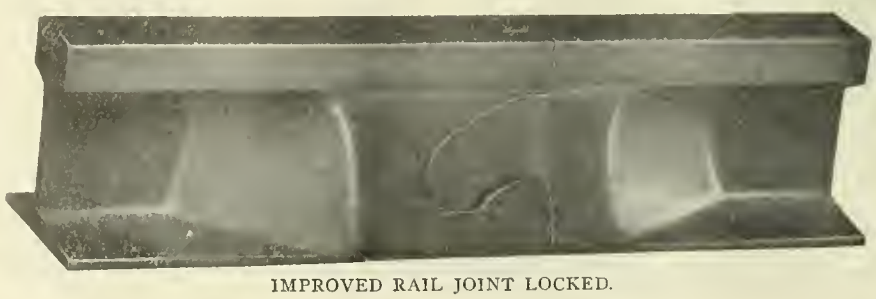
J. F. BARNHILL.

product appears to be a perfect article in this line of endeavor. It precludes the clicking of the rolling stock in transit, as well as the battering of the rail ends. The track is no more liable to spread than elsewhere. A low joint is impossible, as will readily be observed in the illustration, as one rail cannot spring below the other. Fish plates, bolts and nuts are unnecessary. Reinforcements at the joints add strength where it is needed, and the laying of rails cost less than when some other methods of joining are used. It is only necessary to raise the rails eight inches to lock or unlock, and in laying new track the rails can be laid upon their side and locked very easily, and then set over on to the ties right side up. The use of bent wires is no longer necessary where this rail joint is used. Interesting data showing comparative cost of installation, maintenance, etc., as compared with other methods of rail joining are available at the exhibit of this company, as well as numerous letters of commendation from prominent people in the railway field. A very attractive catalogue fully describing this device can be had upon application to the International Inter-locking Rail Joint Manufacturing Co., 1221 Karpen Building, Chicago.

Windows and Doors.

The O. M. Edwards Company shows a line of window fixtures and metal trapdoors suitable for both steel and wood construction. A number of models showing both balanced and unbalanced designs of windows with and without top, bottom and side weather stripping are shown. The fixtures make the sash easy to raise and permit adjusting at any desired height and absolutely eliminates any danger of the sash falling. When closed, the sash is securely locked, and in any position free from annoying rattling.

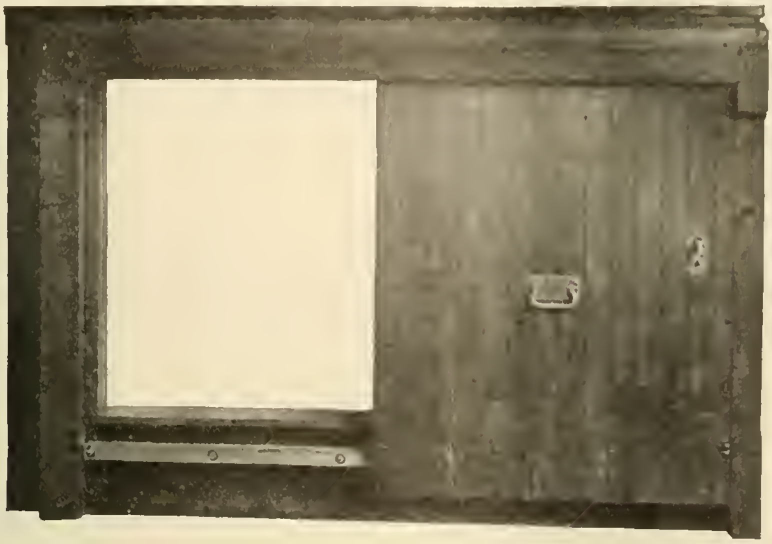
The Edwards trap-door is the simplest and neatest on the market, and is standard on a number of the most prominent steam and electric railroads.



IMPROVED RAIL JOINT LOCKED.

The Rumsey Car Door.

The Rumsey Car Door & Equipment, 1222 Karpen Building, offers an attractive display in the Exhibit, and claim many points of superiority for their door, chief among which are the facts that the door has no useless metal and is responsive to all forms of service, and stands up under all forms of abuse so common in railway service. It is also moisture and burglar proof, and cannot come off unless the car is seriously damaged. It is the simplest door yet placed on the market. It operates with perfect ease regardless of pressure from within. It constitutes a perfect seal when closed and makes an ideal semi-refrigerator door for potato trade and similar traffic, and does away with the need of a special grain door. The large saving in operation can be made readily understood by an examination of the model exhibited. The defects in car doors are too well known to point them out, but the Rumsey company has taken into consideration all of the usual door troubles and some of the unusual door troubles also. The absence of protruding castings is an important feature and one which commands general attention. The Rumsey car door has made its advent at a very auspicious time and the favorable comments by those who have investigated this door is a good proof that it has come to stay. Fuller particulars may be had on application at the company's address as above.



SHOWING CAR DOOR OPEN, SOLID GUIDE RAIL AND SOLID ONE-PIECE DOOR JAMB WHICH STRENGTHENS MATERIALLY THE DOOR OPEN.

Signal Engineers.

A very interesting meeting of the Railroad Signal Engineers No. 5 was held in the Karpen Building, Chicago, Ill., on Friday evening, December 13. The meeting was largely attended and the proceedings were of more than usual interest. The association is particularly fortunate in its choice of active and capable officers, as well as in its choice of headquarters, the membership having increased rapidly since the meetings are being held in the commodious hall of the Karpen Building.

Yard Masters.

The International Association of Yardmasters met in the lecture hall of the Permanent Exhibit on December 15, this being the occasion of their first meeting in this place, and the members were unanimous in praise of the new headquarters. After discussing various matters of importance to their craft, the members took the opportunity to view the fine display of railroad appliances on exhibition.

Other Associations.

Regular meetings of other associations were held on the dates as scheduled in our December issue, and the dates are being rapidly filled up. Among others, the Car Foremen's Association will hold their regular meeting in January, as well as the Car Clerks' Association and the Santa Fe Good Service Meeting, and others, all in January.

The Locomotive Engineers held their December meeting in the large Convention Hall, and the growing increase in attendance speaks well for the continued success of the organization and is also much appreciated by the management of the Permanent Exhibit.

Slope-Staker.

Among the recent additions to the Permanent Exhibit that is attracting considerable attention from among the increasing number of visitors, special mention may be made of the Chicago Steel Tape Company, which, pursuing its policy of putting out only such articles as are decidedly their own inventions or their own improvements on articles already existing, is on the eve of introducing an implement which will very materially simplify the work of setting slope stakes.

This implement, which is to be called "The Slope Staker," is a simple device consisting of light weight graduated rods, arranged to pass through rectangular tubing and controlled by a level bulb so it will instantly show the height and distance out.

With it one man can do the work which requires three, in the common method with an engineer's level and a tape, in much less time and with much greater accuracy.

CLOSED POSITION SHOWING SIMPLICITY AND ABSENCE OF EXTERIOR AND USELESS CASTINGS, ALSO RIGHT-HAND SIDE DOOR LOCK.

It can be used on any cross-section, from the profile and grade notes of the center line. The more difficult the cross-section the greater are its advantages.

It has been repeatedly tested in extensive surveying work in the West and Southwest, and has met with the warmest approval of all who had occasion to test its qualities.

Rugs and Carpets.

We again take pleasure in calling attention to the elegant floor coverings shown by the American Rug and Carpet Company, which occupies a large and prominent space in the Exhibit, and which shows a number of very beautiful rugs, the soft tones of which are brought out by artistic and modified electric lights. In the center of this space is a very fine piece of Sarouk valued at $3,500, and a number of other pieces are shown, artistically draped, of various designs and values. Upon the first floor of the Karpen building, the company carries a large stock of rugs suited to various requirements, and in no other place in the country is a more beautiful display made. All who are interested in artistic floor coverings will find here the best of rugs from all over the world, and at prices to suit particular cases. The courtesies extended by the management of this firm are appreciated by all of the exhibitors, many of whom are indebted to the company for the artistic arrangement of their booths.

Meeting of the Car Foremen's Association.

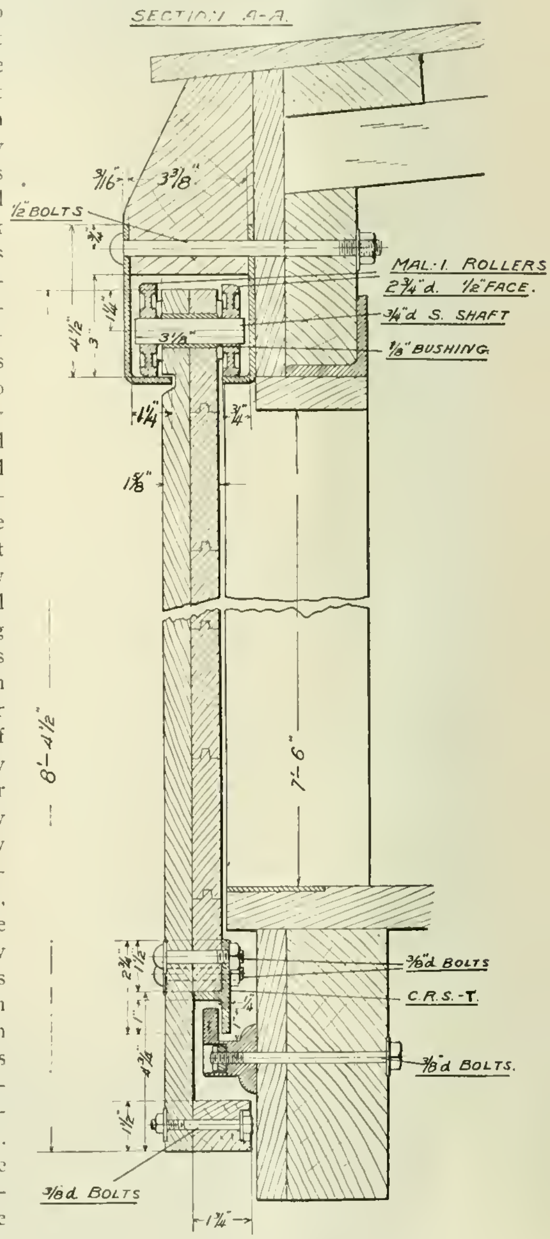
At the December meeting of the Car Foremen's Association held last month in the Karpen Building, Chicago, the attendance was large, and a very interesting discussion on the subject of the Re-weighing of Cars was held, Mr. F. C. Schultz presiding. This popular association was organized in 1894, and its objects are to bring together those interested in car department matters for the purpose of exchanging ideas, discussing questions of interest, with the object of facilitating the movement of cars, and educating the car men to a better knowledge of economy in maintenance of equipment and for the settlement of disputes that the members may bring before the association. These objects are being fully accomplished. The fact that a car inspector can lose more freight for a railroad than the Freight Department can obtain is now being rapidly changed. The membership is from every State in the Union, and particularly in Chicago. There are now over 800 members, about half of them being located in Chicago. We regret that we have not space to present a sample of their proceedings at the December meeting in full, but the following extract from the paper on the Re-weighing of Cars cannot fail to be of interest to our readers:

F. C. SCHULTZ.
President Car Foremen's Association.

Reference should be made to the lightweight on freight cars and the delay caused thereby. Theoretically each car is stenciled to show what it weighs when empty. Inasmuch, however, as the weights change from time to time it becomes necessary to re-weigh them and re-stencil them at intervals. In order to re-weigh all cars at least once a year, it would be necessary to do so at the rate of about seven thousand per day, or eight thousand per working day. This is such a big undertaking that it not infrequently happens that the cars run longer periods of time without being lightweighed and re-stenciled. In practice the lightweight as stenciled on cars differs in some cases from the actual weight and in consequence the shipper and consignees are inclined to require that the cars be lightweighed regardless their stenciling, this in order to make sure that they do not pay more freight charges than they think they ought to pay. If they should dispute the stenciled weight of a car and the car has to be hauled to some weighing point to have the weights verified, the length of time the empty is kept out of service represents delay no matter how rapidly the car may be moving around over the road in reaching the weighing point. It may be felt that such delays are unavoidable and that a delay which is unavoidable is really not a delay after all. It is believed, however, that some of this extra handling can be avoided by working out a plan under which a car when lightweighed and found to carry a stenciled weight differing materially from the actual weight will be immediately re-stenciled. This is, of course, done in the case of a car being on the home road, but it is reported that many cars are lightweighed on foreign railroads without being re-stenciled. One reason this is the case is, I presume, that when the actual lightweight of a foreign car is secured the immediate purpose is accomplished and the road having the car hesitates to hold it until it can be stenciled. In order to re-stencil a car it must be placed on a siding and the painter procured, and then the car must stand a while until the paint dries. This causes a switch to the track and another switch to get it back into the service again. Even though all empty cars were re-stenciled as soon as lightweighed whether home or foreign cars, there still would be less delay incident to their re-stenciling, and it is possible that this delay when encountered can be obviated by the use of a device something like that in effect on the Santa Fe road, whereby the new weight is immediately placed on a car and it is ready for service in a few moments without the necessity of delaying it, thus avoiding the per diem which accrues during its delay.

Fire Clay.

The Fire Clay Development Company are exhibiting various designs of locomotive arches, a variety sufficient to meet all requirements. The bricks are made of very high grade Ohio flint clay especially adapted for use in locomotive fire boxes.



SHOWING HOW THE RUMSEY CAR DOOR EXTENDS INTO THE HOUSING, MAKING IT ABSOLUTELY STORM PROOF.

DIRECTORY OF THE

Permanent Manufacturers' Exhibit Railway Supplies and Equipment

Twelfth Floor, Karpen Building

900 So. Michigan Boulevard, CHICAGO, ILL.

Booth No. 49.

AMERICAN RUG AND CARPET COMPANY.

A complete line of specially designed rugs and carpets for railroad use.

Booth No. 47.

ANDERSON MANUFACTURING CO., THE.

OXY-ACETYLENE WELDING AND RECASTING PLANTS, for reclaiming broken parts of machinery, as well as general repairs.

Booth No. 51.

BARCO BRASS AND JOINT COMPANY.

Flexible Ball Joints. For steam, air and oil connections. Roundhouse Blower sets and blow-off sets.

Booth No. 76.

BOGARDUS COMPANY.

"Tre-Foil" Locomotive Steam Gauges. "Trident Hylo" Water Alarm for water tanks.

Booth No. 11.

CANTON CULVERT CO., THE.

Galvanized, corrugated culverts, made of NO-CO-RO metal, which is a reliable acid-resisting iron of almost 100% purity.

Booth No. 35.

CHICAGO CAR DOOR COMPANY.

The Car Door "that won't come off," unless car is wrecked. Storm, spark and thief proof.

Booth No. 3.

CHICAGO CAR HEATING COMPANY.

Newest system of heating—economical, simple and durable.

Booth No. 19.

CHICAGO STEEL TAPE COMPANY.

Surveying instruments. Common sense things for field work, such as tapes, flag poles, rods, arrows, etc.

Booth No. 50.

COFFMAN'S PERMANENT WAY.

A Permanent Roadbed, formed of concrete, stone and suitable bindings, using a steel tie.

Booth Nos. 7-8.

CRANE COMPANY.

Valves, unions, etc., to meet every demand for steam, water, gas, oil, air, creosote, zinc, Chloride or Ammonia.

Booth No. 12.

CURTAIN SUPPLY COMPANY.

The newest curtain appliances for sleeping, dining cars, coaches, etc.

Booth No. 60.

DEARBORN DRUG & CHEMICAL COMPANY.

Water treatment for prevention of foaming, pitting, scale and leaks in boilers. Made to suit actual water conditions.

Booth No. 11.

DETROIT HOIST & MACHINE COMPANY.

Pneumatic and Electric Turn-Table Tractors. Pneumatic and Electric Hoists. Chain Blocks, etc.

Booth No. 93.

ECONOMY RAIL CREEPER, THE.

A rail creeper pressed from No. 10 sheet steel and secured in place by an ordinary track spike.

Booth No. 56.

O. M. EDWARDS CO., THE.

Window Fixtures and metal trap doors for both steel and wood passenger equipment. Metallic furniture.

Booth No. 118.

M. J. EGLESTON.

General Railway Supplies.

Booth No. 6.

FIRE-CLAY DEVELOPMENT CO., THE.

High-Grade Fire-Clay, Arches for Locomotives and Fire Brick for Oil Burners, also specially designed brick for all refractory purposes.

Booth No. 11.

FLEMING-HEBARD CO., THE.

General railway supplies and equipment.

Booth No. 48.

FROST PAINT AND MANUFACTURING CO.

"KAPAK" and Hydro-Carbon Paints for locomotives and steel cars. SNELLING BOILER COMPOUNDS for scale, corosion, etc., in Locomotive Boilers.

Booth No. 93.

FOREST CITY PAINT & VARNISH COMPANY.

Manufacturers of "NEV-A-RUST" paint, as well as other brands of durable paints.

Booth No. 33.

GOLD CAR HEATING AND LIGHTING CO.

Vapor and Combination Pressure and Vapor system of Car Heating. Ventilators for passenger and refrigerator cars. Acetylene System of car lighting.

Booth No. 104.

HEATH AND MILLIGAN COMPANY.

One of the oldest firms in this line; makers of a long line of paint for every conceivable railroad need.

Booth No. 124.

R. H. HYLAND CO.

Exhibiting the Mulconroy Flexible Metallic Boiler Washout hose.

Booth No. 118.

INDIANA SHOVEL COMPANY.

A full line of shovels and scoops for railroad purposes.

Booth Nos. 21-22.

INTERNAT'L INTER-LOCKING RAIL JOINT COMPANY.

A flexible bond between rails without plate, bolt or nut.

Booth No. 4.

JOLIET RAILWAY SUPPLY COMPANY.

Displaying the Huntoon Safety High Speed brake beam for P. C. Air Brake Equipment. Perry Self-Centering Anti-Friction Roller Side Bearings, etc.

Booth Nos. 106-107.

KARPEN & BROS., S.

Quality makers and designers of artistic furniture for dining and parlor cars.

Booth No. 58.

KENNICOTT COMPANY, THE.

Water Softening Machinery. General Steel Plate Construction. Underframe, Tank Cars, Water & Oil Tanks, Riveted Pipe Track Troughs, etc.

Booth No. 118.

KLEANSALL MANUFACTURING COMPANY.

A vegetable oil soap unsurpassed for cleaning painted or varnished surfaces without injurious effects. Very effective for cleaning the interior of passenger equipment.

Booth No. 73.

KINKAID BRAKE SHOE CO., THE.

A FLANGE LUBRICATOR for lubricating the flanges of engine wheels, car wheels, etc.

Booth No. 24.

KNEEDLER, COUCH & HANSEN.

Displaying the Kneedler steel reinforced concrete railroad tie. Efficient, reliable, safe and durable.

Booth No. 17.

L.-J. DEVELOPMENT COMPANY, THE.

Displaying an Automatic Connector for Steam, Air and Signal Lines, as well as electric connections.

Booth No. 26.

MACRAE'S RAILWAY & SUPPLYMEN'S MUTUAL CATALOGUE.

It affords the real short cut for the use of supplymen in bringing their products to the attention of railroad purchasing agents.

Booth No. 118.

THE J. MILTON HAGY WASTE WORKS.

Cotton Waste. Wool Waste.

Booth No. 94.

MILWAUKEE CONCRETE MIXER & MACHINERY CO.

Concrete Mixers and Machinery, etc., for railroad and other uses.

Booth No. 11.

MODOC CO., THE.

The Modoc car cleaner is a preparation for use in cleaning exterior and interior of car bodies.

Booth No. 87.

THE NATIONAL REFINING CO.

Oils in great variety.

Booth No. 121.

NICKEL-CHROME CHILLED CAR WHEEL COMPANY.

Nickel-Chrome Chilled Car Wheel gives 500% greater strength of flange than ordinary chilled wheel under Lobdell Flange Test.

Booth No. 31.

OGLE CONSTRUCTION COMPANY.

Steel Coaling Stations with automatic coal handling machinery.

Booth No. 118.

T. M. PARTRIDGE LUMBER COMPANY.

White Cedar Poles, posts and piling for railroad use.

Booth No. 92.

PUBLIC CUP VENDOR COMPANY.

Owner of Luellen Patents on Individual Drinking Cups and cup dispensing apparatus.

Booth Nos. 14-15.

PYLE-NATIONAL ELECTRIC HEADLIGHT COMPANY.

Displaying their Type "E" turbo-generating set, which evaporates less water per E. H. P., than any other turbo designed for like service.

Booth No. 10.

RAILWAY UTILITY COMPANY.

Displaying Car Heating apparatuses, Car Ventilators and Lamp Jacks, Automatic Freight Car Door Locks and Portable Electric Vacuum Car Cleaners.

Booth No. 122.

RUMSEY CAR DOOR & EQUIPMENT CO.

The door that is absolutely burglar and moisture proof.

Booth No. 30.

SARGENT COMPANY.

Safety water gauges for locomotives. The Ironclad water gauge and the Safety water gauge cocks, also manufacturers of E. S. E. blow-off valves.

Booth No. 71.

ST. LOUIS TRUCK AND MANUFACTURING COMPANY.

Manufacturers of the famous SELF-OILING STEEL TRUCKS.

Booth No. 11.

STERLING VARNISH CO., THE.

Reliable metal preserving paints for bridges, coal, and gondola cars.

Booth No. 57.

U. S. METALLIC PACKING COMPANY, THE.

King-Type Metallic Packing for valve stems, piston rods of locomotives, etc. Air Pump Packing. Gollmar Bell Ringer and the Leach Sanders.

Booth No. 75.

U. S. WIND ENGINE AND PUMP COMPANY, THE.

Displaying Water Columns, Locomotive Watering Devices, Pumping Machinery, Switches, Semaphores, Windmills, etc.

Booth No. 32.

VERONA TOOL WORKS.

Track Tools and Nut Locks.

Booth No. 72.

WILCOX ENGINEERING COMPANY.

Wilcox Feed Water Weigher keeps tab on the evaporation costs.

Booth No. 25.

WIRE-WOOD SEAL COMPANY, THE.

Displaying a new device for sealing cars. Un-interchangeable easily stocked, quickly applied, scientifically safe and economical.

Trade Publications.

American Engineer......	Booth	No.	18
Railway Age Gazette...	"	"	18
Railway and Engineering Review	"	"	105
Railway List Co.	"	"	119
Railroad Herald	"	"	79
Signal Engineer	"	"	18

Booth No. 96.

Augus Sinclair Company, Publishers

RAILWAY AND LOCOMOTIVE ENGINEERING.

(Official Organ of the Exhibit.)

Railway and Locomotive Engineering

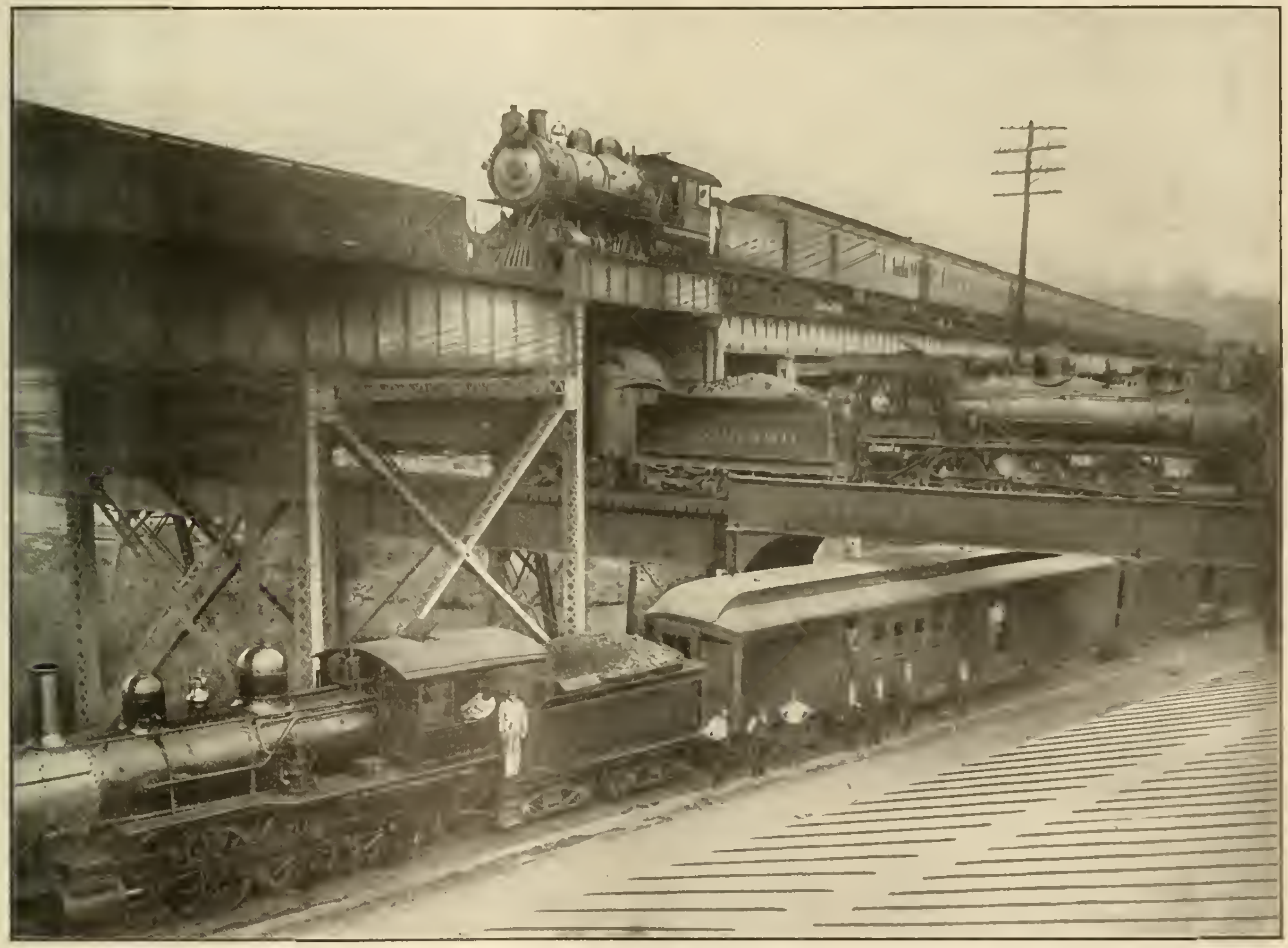
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVI. 114 Liberty Street, New York, February, 1913. No. 2

Three Trunk Lines Crossing Each Other

The accompanying unique illustration presents a view of the only point in the world where three separate trunk lines may cross over or underneath each other at the same time and over their Southern railway, proceeding towards West Point, Va.

It is not unusual to see the combination of three trains crossing this triple junction as many trains pass and re- ment to their ability for many generations to come. It will doubtless be remembered that there are bridges above bridges crossing the Mississippi river between St. Louis, Missouri and East



THREE TRUNK LINES CROSSING EACH OTHER AT SIXTEENTH AND DOCK, RICHMOND, VA.

separate tracks. On the top track is shown a passenger train of the Chesapeake & Ohio railway coming from the upper James River Valley to Richmond, Va. Just beneath it is a train of the Seaboard Air Line railway, coming into Main Street Union Depot, and on the ground track is a view of a train of the pass the point every day. The structure, it will be observed, is of a complex but substantial kind, and withstands the great and growing traffic. The constructing engineers had in their minds the ever increasing weight of locomotives and rolling stock, and the triple crossing will be a lasting monu- St. Louis, Illinois, but the bridges between these cities bear no relation to each other further than their nearness. American engineering skill seems prepared to meet any condition, and rather prefers to meet a complex situation where at first sight the difficulties might seem insurmountable.

First Train On the New Branch of the Western Maryland.

The accompanying illustration shows the first eastbound train, consisting of forty cars of tubing from the mills of the National Tube Works, McKeesport, Pa., which were moved over the new extension recently completed and now in operation between Connellsville, Pa., and Cumberland, Md., connecting with the Pittsburg & Lake Erie railroad at the former place, and the West Virginia division of the Western Maryland railway at Cumberland. This new extension is about eighty-eight miles in length and places the Western Maryland railway in the position of being the only single track trunk line in the East, and giving the New York Central Lines a direct outlet to tidewater through the port of Baltimore.

The road now extends over seven hundred miles, from Baltimore to Huttonsville and Durbin in West Virginia and Connellsville, with connection direct to Pittsburgh as already stated. Important branches also run to York and Shippenburg, Pa., one branch passing the famous battlefield of Gettysburg. There are 218 locomotives in service, and the equipment will compare favorably with that of many of the larger Eastern railways. In addition to the large and rapidly increasing freight traffic the year's traffic has been marked by a vastly increased tourist traffic, much of the road passing through romantic and beautiful scenery, of which the illustration may be taken as a sample.

FIRST TRAIN ON THE NEW BRANCH OF THE WESTERN MARYLAND RAILWAY.

Flashlight Signals on the Swedish Railways.

It is interesting to observe that extensive and satisfactory experiments have been made with flashlight signals on the Swedish railways, and that a complete installation of the system has been made on a portion of the main line of the Southern Division of the State railways. The home signals carry several arms to indicate the directions in which trains may run. The flashlight was equipped to the top arm—that leading to the main line—in each case, and the other arms had ordinary steady lights which were, however, only turned on full when the signal was pulled off. The light is turned up and lowered by means of a valve similar to that in use in the flashing arrangement. But it must be remembered that although this valve is used in the lower signals the light there is a steady one, when lowered or raised, and not a flashlight; the flashlight is reserved for the top arm only. In addition to the top arms of the home signals being equipped, flashlights have been provided for the starting signals for leaving the main lines, and to the distant signals.

Investigations have proved that all of the claims made by the promoters of the system have been substantiated and all the expectations realized. This has been accomplished in the face of very severe climatic conditions, including the severest kinds of snow-storms.

Mr. E. G. Windahl, the signal engineer, has perfected several improvements during the experiments, one of which provides for a through-passage signal indicating that the train may run past the station without stopping. This scheme has been made the more possible by the use of the flashlight for the night indications. The additional arm for the through running is fixed about 15 feet from the ground, and below the other arms. The distant signals are discs which are vertical when "on" and turn to horizontal when "clear" has to be indicated. The extra arm is vertical with the post, like the signal arms in Germany, and is fish-tailed. When the through line home signal is "off" the disc is turned and the lower arm remains out of sight. When the diverging line home signal is "off" the disc is turned and the lower arm is inclined 45° to the left through the upper quadrant. When the home signals are at danger the disc is not turned nor the lower arm seen. The disc is provided with a flashlight. When the disc is on a yellow spectacle is before the lamp, and when the disc is turned a green spectacle replaces the yellow. The lower arm has a steady light, but it is low and obscured when the arm is vertical, but is raised by a valve being automatically opened when the signal is inclined and this brings a green spectacle before the lamp. The sequence then is:—

Through line clear indicated at night

by a flashing green light; diverging line clear by a flashing green light and a lower steady green light. There are 60 flashes to the minute and the duration is 0.1 sec. light and 0.9 sec. dark.

The home signals are similar to those in Germany. There are two arms, one above the other at about 6-ft. centers. The upper arm normally points to the left and, when moved, rises to an angle of 45°. The second arm is normally vertical with the post and points upwards. When moved it falls to an angle of 45° to the left. The additional arm that has been provided about 15 ft above ground level also points to the left. It has an arrow point at the end similar to the new type of distant signal arm recently adopted on the Belgian State railways.

No less than five different indications can be given by these signals. Normally the top and bottom arms are horizontal and pointing to the left and the middle arm is vertical. This indicates stop. The raising of the top arm, the others being normal, means that the main line is clear but that the train must stop at the platform. The raising of the bottom arm in addition to the top one—the middle remaining normal,—signifies that the main line is clear and that the train may run through the station, i. e., through passage on the main line. The raising of the top arm and the lowering of the middle—the bottom arm remaining normal, i. e., horizontal and pointing, indicates that the diverging line is clear and that the train must stop in the station. The raising of the top and bottom arms and the lowering of the middle one signifies that the diverging line is clear and that the train may run through, i. e., through passage on the diverging line. Briefly, then, the symbols are that the top arm is always lowered for "line clear" and the second arm always comes into view for the diverging road and the bottom arm is always used to indicate a through passage.

When the upper arm of the home signal is at danger a steady red light is given as the night indication, and when it is "cleared" by being raised to an angle of 45° a steady green light is shown. When the second arm is normal, i. e., vertical with the post, no light is shown, but when it is used and lowered to an angle of 45° to the left a steady green light is given. When the bottom arm is normal and the top arm at danger practically no light at all is given, but when the top arm is lowered to "clear" this light is turned up and gives a flashing yellow light, and when the bottom arm is cleared for the through passage a flashing green light is shown. Briefly, then, the night indications are: For danger, a steady red light; for main line clear, stop at platform, a steady green and flashing yellow; for main line clear and run through, a steady green and a flashing green; for the diverging line clear, stop at platform, two steady green lights and a flashing yellow; for diverging line clear and run through, two steady green lights and a flashing green.

For the home signal the number of flashes is 85 per minute and a duration of 0.1 sec. light and 0.6 dark, as compared with 60 flashes per minute—0.1 sec. light and 0.9 sec. dark—for the distant signals.

Increase of Safety on the New York Central Lines.

In reporting on the record of personal injuries on the New York Central Lines, Mr. George Bradshaw, general safety agent, furnishes a tabulated statement embracing the entire system, and in noting the comparison between corresponding periods immediately before and immediately after the organization of the safety department, which shows a decrease of almost 20 per cent. in the number of employees killed, it should be borne in mind that the volume of business for the 1912 period was much heavier and consequently the number of persons employed considerably greater than in the 1911 period. For this reason, therefore, the real decrease, if figured on volume of business and number employed, would show much more than 20 per cent.

This favorable record is due to the cooperation of officials and employees in the movement of greater safety, and we trust it will afford an encouragement to continued efforts in that direction.

Red Cross Car on the Lehigh Valley.

The first-aid-to-the-injured car of the American Red Cross Society is now in full operation on the Lehigh Valley Railroad. It stops at all the division and terminal points. Two physicians are in charge of the car, and they show the railroad workers how to attend to injuries. The railroad men turn out in large numbers, at the noon hour and in the evening, when the lectures are in progress. At every stop not only the Lehigh Valley employees, but the men on other railroads and in nearby manufactories, are invited. Evening demonstrations are made easy by connecting the electric light fixtures, with which the car is equipped, with wires from the local lighting plant.

Plans for Electrification of the Chicago, Milwaukee & Puget Sound Railway.

The recent announcement made by President A. J. Earling, of the Chicago, Milwaukee & Puget Sound Railway, that the mountain division of its main line between Harlowton, Mont., to Avery, Idaho, a distance of 440 miles, would be electrified, was received with a great deal of interest by all railroad men. To handle the trains over this distance probably 100 locomotives would be required, and it will require several water-power developments to supply the necessary electrical energy. No detailed plans have been made but it is intended to operate all the traffic with electric locomotives. Part of the railroad power will be supplied by the Great Falls Power Co. and a grant has already been obtained for transmitting this power to the railroad at very high voltage.

The above announcement is very interesting and brings out the fact that the electric locomotive is a very efficient machine for railroad work, especially where severe service is required. The steam locomotive is more or less limited in size, for it is self-contained, whereas the electric locomotive receives its power from a large unit known as the power house, located perhaps several miles away, in as large quantities as necessary.

Practically all of the weight of the electric locomotive is in drivers and due to the uniform tractive-effort at the drivers, there is less tendency for the wheels to slip than with the steam locomotive where the tractive-effort is variable. The operation of electric locomotives together controlled by one man is an important consideration over heavy mountain grades. Only one crew is necessary and the cost of operation is much less as with the steam operation a crew is required for each locomotive.

Burlington Offices.

The new Burlington Railroad offices on Jackson Railroad Boulevard, Chicago, have been opened and provide accommodation for 2,500 employees. They are provided with the latest conveniences for health and comfort. There are pneumatic tubes for carrying papers and letters between the various offices, there are rest rooms for women, sanitary drinking cups and excellent lighting. They are the largest railway offices in the United States.

The merchant shipping of the world numbers about 30,000 vessels large enough to be used on important bodies of water. That means one to every 5,000 square miles of sea, which would give a space the size of Ohio only eight ships if they were evenly distributed throughout the globe.

The Burlington Railroad has ordered new dining cars that will cost $90,000. The travel outlook justifies this large outlay of money.

Mammoth Mallet Articulated Compounds on the Virginian R. R.

Numerous enquiries having reached us in regard to the exact dimensions and capacity of the mammoth Mallets recently constructed by the American Locomotive Company for the Virginia Railway, and of which the most gratifying records are being made, we are pleased to be able to reproduce a photograph of one of these locomotives. Many of our readers are aware that we recently issued an illustrater poster showing a view of this great locomotive, and the interest these particular engines seems to be very widespread. With a tractive effort of 115,000 pounds and a total weight of engine and tender amounting to 744,000 pounds, these engines are in a class by themselves.

It may be stated that the crucial point on the railway is a portion between Elmore and Clark's Gap, on the Deepwater division, a distance of about 14 miles, nearly all of which is on a 2.07 per cent.

The grates are power operated—the Franklin Railway Supply Company's power grate shaking system being applied.

The following are the principal dimensions of these locomotives:

Track gauge, 4 ft. 8½ ins.

Cylinders—Diameter, 28 ins. and 44 ins.; stroke, 32 ins.

Wheel Base—Driving, 15 ft. 6 ins. and 15 ft. 8 ins.; total wheel base, 57 ft. 4 ins.; engine and tender, 91 ft. 5 3/16 ins.

Driving Wheel—Diameter, 56 ins.

Boiler—Diameter, 100 ins.; pressure, 200 lbs.

Firebox—Length, 132 ins.; width, 108¼ ins.

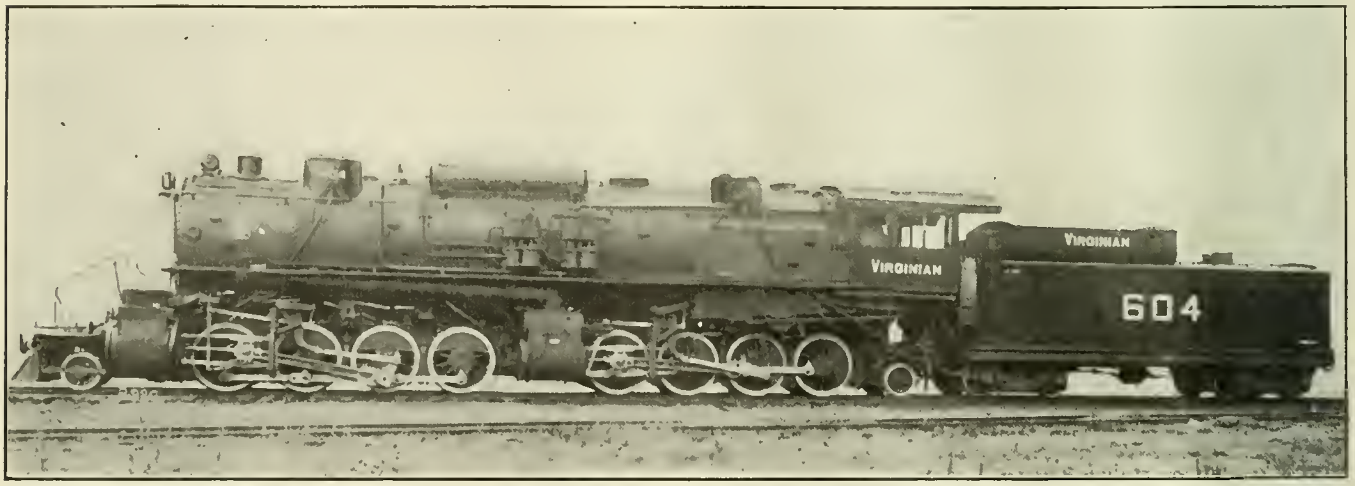
Tubes—No. 334, 2¼ ins. diameter; No. 48, 5½ ins. diameter; length, 24 ft.

Heating Surface—Tubes, 6,348.7 ft.; firebox, 410.2 sq. ft.; water tubes, 69.3 sq ft.; total, 6,828.2 sq. ft.; superheater, 1,320 sq. ft.; grate area, 99.2 sq. ft.

Passenger cars seldom carry more than 50 passengers each, so it would take a train of 100 cars to carry that huge steamer's passengers. If 80 Mallet locomotives were started pulling 100 passenger cars we would have an equal of the *Imperator's* load.

Among other luxuries the *Imperator* is fitted with three electric elevators, a winter garden, summer houses, a theater, a gymnasium, a Ritz restaurant, swimming baths, a ballroom, telephone and a cottage café. The swimming bath is the copy of one unearthed at Pompeii, with mosaic pavements that are reproductions of those discovered at Treves. The first class dining saloon is in the Louis XVI style. It is 300 feet long.

With all its size, power and luxuries this vessel would go to the bottom of the ocean as readily as the *Titanic* went when attacked by the same forces.



MALLET ARTICULATED 2-8-8-2 LOCOMOTIVE FOR THE VIRGINIAN RAILROAD.

F. T. Slayton, Supt. Motive Power. American Locomotive Company, Builders.

grade with maximum compensated curves of 12 degs. The trains have been operated over this grade with one Mallet of the lightest class at the head, and two of the heavier locomotives as helpers. With this power, the maximum train over the mountain averaged 3,340 tons. With two of the new locomotives as helpers and one of the older class having 92,000 lbs. tractive power, making a combined tractive force of 332,000 lbs., it is expected to take a train of 4,230 tons over the grade.

Several additional new features are found in the design and construction of the boiler. One of these is the arrangement of the fire brick arch employed. It consists of a combination of the Security and the Gaines brick arch. This gives a largely increased firebox volume, although the grate area, 99 ft., is less than that provided in other large Mallets constructed by the same builders.

Tender—Capacity, water, 12,000 gals.; fuel, 16 tons.

Weight in Working Order—Leading, 34,800 lbs.; driving, 479,200 lbs.; trailing, 26,500 lbs.; engine, 540,000 lbs.; tender, 204,000 lbs.; factor of adhesion, 4.17.

The Greatest of Steamships.

One of the latest triumphs of engineering science is the steamship *Imperator* belonging to the Hamburg-American Company which is expected to start on its first voyage to New York May 7. This is the largest vessel in the world. The *Imperator* is an eleven story floating palace, 919 feet long, driven by engines which develop 80,000 horse power, with a displacement of 50,000 tons and capable of accommodating 5,000 passengers.

It is difficult to find in railway practice parallels to the *Imperator's* power and capacity. The most powerful Mallet locomotives rarely develop 1,000 horse power.

Most travelers would be willing to sacrifice the mosaic pavements and Pompeian baths for evidence of safety appliances which would help to keep the vessel afloat.

There are many thousand coal mines in the United States, but more than half of the coal comes from 735 mines, which yield more than 200,000 tons apiece in an average year. The biggest anthracite mine has a record of about 1,142,000 tons, and the largest bituminous mine has produced 1,285,000 tons, or more than 100,000 tons a month. Both of these record mines are in Pennsylvania.

Not many years ago Russia was a strong rival of the United States in the production of petroleum. Now the Russian Empire yields only about 68 per cent. as much oil as California alone, and not much more than Oklahoma.

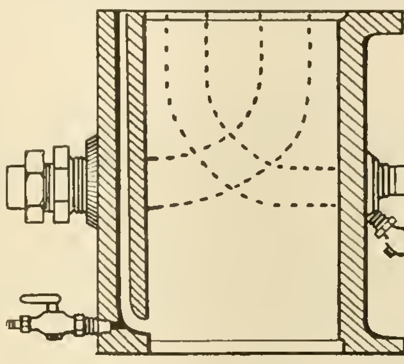
General Correspondence

Air Pump Steam Cylinders Bursting in Zero Weather.

Editor:

Being interested in air brakes, I have noticed several articles written by subscribers of your paper on how to repair cracked steam cylinders. While there are various ways of repairing cracked steam cylinders the method to be employed depends on the location and the kind of crack you have to repair. I do not think that those who are interested in air brake repairs should let these different methods of how to repair steam cylinders on air pumps be a final cure for this evil, but I believe it is our duty to try and find a way to prevent these cylinders from freezing so as not to have any to repair.

From my experience with broken steam cylinders and what I believe to be responsible for 90 per cent. of the bursted steam cylinders due to freezing after various precautions have been taken to prevent it. The company with which I am employed has adopted as standard for their 9½ and 11-inch pump the Westinghouse right and left reversible passage steam cylinders. With the adoption of this type of cylinders we came to the conclusion that this was the cylinder we wanted from the fact that it could be made to suit the right or left hand side of the boiler without running the pipe around the pump as is the case when the direct passage right hand cylinder is applied to left side of boiler. But I believe we failed to realize at that time that these reversible passages form water and air traps, and they will do more damage in one winter due to freezing up and bursting than the direct passage cylinder would do in ten winters with equal amount of cylinders in service. The shop where I am employed turns out an average of 100 pumps per month, and nearly all cracked steam cylinders are sent to this station for repairs from line of road, and my experience has been that 99 per cent. of the cracked cylinders received by me for repairs are the right and left hand reversible cylinder; and from careful checking and investigations I decided that they were an expense instead of a benefit to the company and I have recommended that they adopt a direct passage left hand cylinder as shown on sketch enclosed. This type of cylinder I believe will be a great benefit and decrease the amount of bursted steam cylinders to a fraction, while I realize the direct passage right hand cylinder is equally as good as the one shown in sketch as far as safety is concerned, yet it has its objections on account of having to run the live steam and exhaust pipe around the pump when pump is placed on left side of boiler. The right and left hand cylinder may be a benefit in a way, where some railroads have some pumps on right and some on the left hand side of boiler; but as nearly 100 per cent. of the engines on the railroad have the pumps on the left hand side of boiler, I cannot see any benefit in holding to this class of cylinder when the evidence shows that many of the bursted cylinders are of this type. I would be pleased for everybody concerned to get in on this subject and offer as much criticism for or against these recommendations as they can so we



IMPROVED AIR PUMP STEAM CYLINDER.

may be able in the near future to correct this expensive and troublesome proposition.

Wm. S. Everly,
Foreman Air Brake Repairs.
Mt. Clare B. & O. R. R., Baltimore, Md.

The Electric Locomotive.

Editor:

The general tendency among European engineers seems to be strongly in favor of the multiple-unit-control system in which a fair proportion of the coaches of each train, usually one-half or one-third have their own motors. On the other hand it is possible that a modification of the electric locomotive from the present types may influence its position as a tractive machine. In Great Britain all the electric railways employ motor coaches, sometimes with trailers attached, instead of electric locomotives. On the London underground railway a number of electric locomotives are no doubt at work, but they are employed to haul steam trains, which have come in from the main provincial railway system. There are a limited number of small electric locomotives employed for hauling in mines and on other industrial lines; whilst on the Continent a number of lines employ locomotives of this type. In the United States there are several notable examples of railways employing electric locomotives for normal passenger traffic.

Commercial electric locomotives take current from wires or rails fed from a central power station, just as do motor-coaches in trains on the multiple-unit-control system. Thus apart from the trains themselves, the two systems are on an equal footing. In Great Britain the electrification has only been applied to passenger traffic, thus on one line running out of Liverpool goods trains are still hauled by steam locomotives, although passenger trains have used the competing system for some time. The most important need of a busy traction system, such as occur in the suburban districts of large centres of population, is for high speed trains of moderate length, run at very frequent intervals. Trains which gather speed rapidly are essential and the multiple-unit system possesses marked advantages in this respect. It also possesses advantages in the case of trains running into terminal stations; this advantage being probably more marked in the case of suburban lines radiating from a large town. The electric locomotive as it at present exists possesses certain advantages also. It enables electrification to be carried out with a minimum expenditure on new rolling stock; it avoids the use of electric power cables on passenger coaches and thus reduces shock and fire risks, and it facilitates the hauling of steam passenger or goods trains over an electrified section. The electric locomotive has not yet been designed for goods traffic, but for suburban passenger traffic the advantages of the steam locomotive are more than offset by their disadvantages.

A new type of electric locomotive was introduced early last summer, which embodies features which materially modify the case for and against the electric locomotive. It is known as the Reid-Ramsay locomotive and is in effect a travelling electric power station. It consists of a boiler, an electric generator driven by a steam turbine and one or more electric motors coupled to the driving wheels. As compared with the steam locomotive it possesses two principal advantages. Reduction of the coal consumption by approximately fifty per cent. and superiority as a traction machine. The improved coal

consumption is obtained by employing an economical type of steam turbine in place of a simple expansion and therefore relatively uneconomical reciprocating engine, also by working condensing. As regards traction characteristics the electric motor can, if a proper supply of power is available, exert a much greater pull at low than at high speeds and hence can accelerate a train rapidly after a stop; a feature of special importance for suburban traffic but less so for goods traffic. On the other hand the maximum pull which a steam locomotive can exert is limited by the boiler pressure and the diameter of the cylinders, but is independent of the speed.

SCHOOL OF ENGINEERS AND FIREMEN, STATE RAILWAY OF CHILE.

The steam turbo generator of the recently introduced electric locomotive runs at constant speed whatever the train speed and can therefore develop its maximum power whenever required, as when the train is accelerating; it follows that within limits the steam-electric locomotive can accelerate as rapidly as an externally fed locomotive and certainly more rapidly than the steam locomotive. Indeed it will probably be found that the limits to accelerating power above mentioned are set by the adhesive power of the driving wheels, which being limited by the dead weight of the locomotive may be insufficient for very high accelerations, such as are required for the most exacting suburban lines. The advantages of the steam electric locomotive over steam traction are definite and great; its disadvantages can only be fully determined by more extended experience; it is highly probable that the electric locomotive will cost more than the ordinary reciprocating steam locomotive and it is also possible that it may be more costly in repairs and maintenance.

A comparison of the turbo-electric locomotive with other forms of electric traction suggests that the former possesses the very great advantage of not requiring any modification or addition to the permanent way. No electric cables, overhead wires, or collector and return rails are required; moreover no heavy expenditure need be made on electric power stations and the transition from direct steam to electric traction can be made as gradually as desired and extended just so far as experience may prove desirable; the system can be withdrawn should an unprofitable extension have been made. Through running is also not interfered with in the slightest degree; these advantages of this type of electric locomotive would weigh most heavily in the case of main line traffic. So far the estimated capital expenditure involved in a normal electrification has proved prohibitive in Great Britain on the main trunk lines; there being no reason to think that reduced operating costs and increased revenue would between them pay for the capital outlay. On the other hand some of the special advantages of normal electrification would be lost.

The increased capacity of teminal stations which results from an electrification on the multiple-unit system would not be obtained, nor would the very high accelerations which are desirable in the most exacting class of suburban service. Both these disadvantages could be partially overcome by placing the motors on the coaches instead of the locomotive. Multiple-unit driving would be secured and shunting of locomotives at terminal stations would then be unnecessary; on the other hand this would add very considerably to the weight of the train. Generally the turbo-electric locomotive shows to most advantage for main line traction and to least advantage for a heavy suburban traffic running into a busy terminal station, over a road involving frequent stops and high average speeds. The same may be said of an electric locomotive in which an oil or gas engine is substituted for a steam turbine; the former would still further reduce fuel costs that would be more costly in the first place and would have to be heavier.

TH. OSBORNE,
Manchester, England.

In Chile.

EDITOR:

The Central Railway in Chili beginning at Valparaiso and ending at Puerto Montt about 13,000 kilometers, is divided in four sections. Among these, the third section, with headquarters at Concepcion has been the foremost for its better shop organization and road service. From its early days till now its motto is "Labor and Cleanness" (Trabajo i Limpieza, in Spanish,) proving in this manner that the seed spread by the pioneer British drivers and shop men 30 years ago grew strong in growth and maintenance.

FIRST LOCOMOTIVE BUILT IN CHILE WITH WALSCHAERTS VALVE GEAR.

As an evidence of the spirit of progress on this third section I enclose three photographs. The first one showing a group of scholars of the first school for drivers and firemen opened on the State Railway of Chili. The second shows engine No. 116 built at Concepcion shop under supervi-

sion of Mr. Jorge Beaumont, chief engineer, having on this locomotive the peculiarity that it is the first one equipped with the Walschaerts gear made in Chile, being designed by Mr. J. Aldea, assistant engineer. The third photograph shows a group with these gentlemen and the manager of the section at the center. In the background is Mr. S. Gray, a very old friend of Railway and Locomotive Engineering and the most enthusiastic instructor of the shop boys.

Heriberto Munoz B.
Concepcion, Chile.

GROUP OF OFFICIALS OF THE STATE RAILWAY OF CHILE.

The Use of Sand.

Editor:

I read with interest the article on sand, by Mr. F. E. Patton. I have often seen a certain engineer start his train of seven Pullmans and his engine rarely slips. His engine is a 4-4-2, which is the most slippery type of engine used in this country, especially if equipped with the Walschaerts or other radial gear, as this particular engine is. All his starts are made from a point where he backs up to the train, so that there is no sand under the drivers at the start, when the chance of slipping is greatest. The way he does it is as follows: First he starts the sand, then opens the throttle but does not open the cylinder cocks. If the slack is pulled out of the train and each of the cranks are on an eighth, the train probably will not start. Many engineers would take up slack in such circumstances. This one, however, waits. The cylinder cocks being closed, the pressure in the cylinders gradually increases with the result that in less than ten seconds the engine has started the train without slipping. It is seldom that the method fails and that he has to take up slack. As soon as the wheels are turning he opens the cylinder cocks. This is a kink that would be a saver of time and of many other things to a man running a 4-4-2, or, in fact, any engine that has to start a heavy train.

Slipping is probably considered insignificant by most railroad men, but slipping many times every day in the year will show on coal, water and wear.

Wm. G. Landon.
New York, N. Y.

Pay-Car Engine.

Editor:

To anyone fond of locomotives, I mean to those who look upon an engine as something more than a mere machine to pull trains with, the present tendency toward highly standardized motive power on our railroads has done much to do away with the individuality of different engines.

Therefore it is interesting to find one road, the greatest in the United States, where a somewhat different policy prevails. In spite of the fact that the Pennsylvania Railroad was the first road to establish a class of standard locomotives, a few special engines have always been fitted up for the use of the officers of the road, etc. The machines, while standard in all essential particulars with others on the system, have a few little touches which give them an individuality and make them objects of admiration for the men who run them.

The accompanying photograph shows Philadelphia, Wilmington and Baltimore Railroad locomotive No. 5180, the engine which hauls the pay car over this division of the P. R. R. The engine is of the American type, known as old Class P or new Class D-13a, and was built at the company's shops in Altoona in 1892. The cylinders are $18\frac{1}{2}$ x 24 inches and drivers 68 inches in diameter. As will be seen, the engine has highly polished cylinder head covers, bell, hand rails, safety valves, whistle, etc., and handsome wheel covers over the drivers. Mr. Lewis Brown, of Wilmington, the engineer, is very proud of the engine and keeps her in splendid shape.

Older P. R. R. men will remember when all the passenger engines of this road were fitted up in a similar manner to 5180, but about twelve years ago the company did away with the extra finish on all but special engines.

The photograph was taken near the old Bay View roundhouse, a short distance out of Baltimore, Md.

Hugh G. Boutell.
Washington, D. C.

A PENNSYLVANIA PAY-CAR ENGINE.

New False Valve Seat.

Editor:

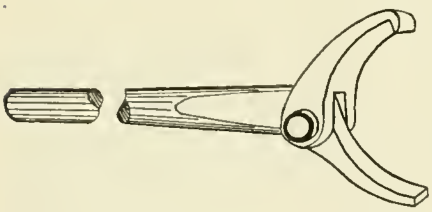
In regard to the necessary operation in attaching a new false valve seat, begin by truing up the cylinder, or what is left of the old valve seat, either with a valve facing machine or by hand; bring the seat to a good bearing; also the bottom of the false valve seat, fitting the one to the other and finishing with a scraper. If the seat has wings to fit inside the steam chest, first screw the corner steam chest studs into place at each of the four corners, then clamp the false seat true with the edges of the steam ports in the

cylinder or old seat. Then put on the steam chest and scribe each of the four wings inside of the steam chest; then remove the steam chest and false seat and have the ends of the wings jumped off or fit and file them to fit the steam chest. If the false seat has no wings, then on the face of the old seat drill, counterbore and tap about sixteen holes for screw bolts, placing two or three in each bridge. Screw the bolts down solid, tapping the seat lightly with a hand hammer to see that each bolt is tight. If the tap bolts are of brass cut them off flush with the face of the valve seat, but if they are of wrought iron cut them off so that the top of each head will be one-sixteenth of an inch below the face of the valve seat. After all the bolts are in place use a face plate and bring the valve seat to a good bearing.

As a finishing to the job try the valve that is to be used on the engine on the seat to which it belongs and see that there is no rocking or other inequality on the two faces. The tendency of the valve itself to be slightly warped on the planing machine is very great. The facing of the two bearings need not be very exact, as the friction incident to the motion of the valve will soon bring the joints to a perfect bearing, but there should be no warp on the faces to start with.

S. Macleay.

Philadelphia, Pa.



ADJUSTABLE SPANNER.

Spanner, Grease Press, and Oil Filler.

Editor:

The accompanying illustration shows a home made union spanner or wrench, which has been found to be very handy in dismantling or coupling up locomotive injector piping. It has the advantage of adapting itself to two or three different sizes of union nuts, and as is shown by the drawing is very easy of construction.

The second drawing, or Fig. A, shows a home-made grease press for pressing locomotive main and side rod grease to proper size to suit the plug holes on the side rods. A is the main body standing on four bolts F. B is the collar that fits the opening at C. D is the piston that fits the cylinder E. The piston D is tightened up on hydraulic press, which is found in many roundhouses, with the screen G.

Also Fig. B is a home-made oil filler for filtering the oil A into the oil tank. B is the receiver tank. C is the water, and D. D. D. is a copper screen.

J. G. Koppel.

Montreal, Canada.

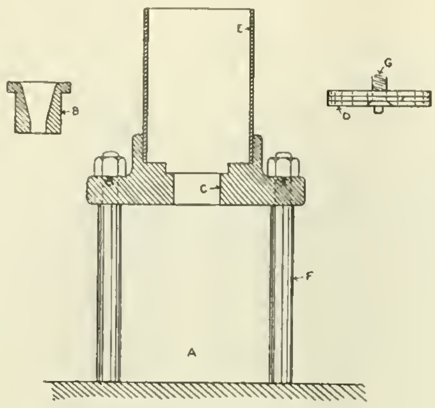
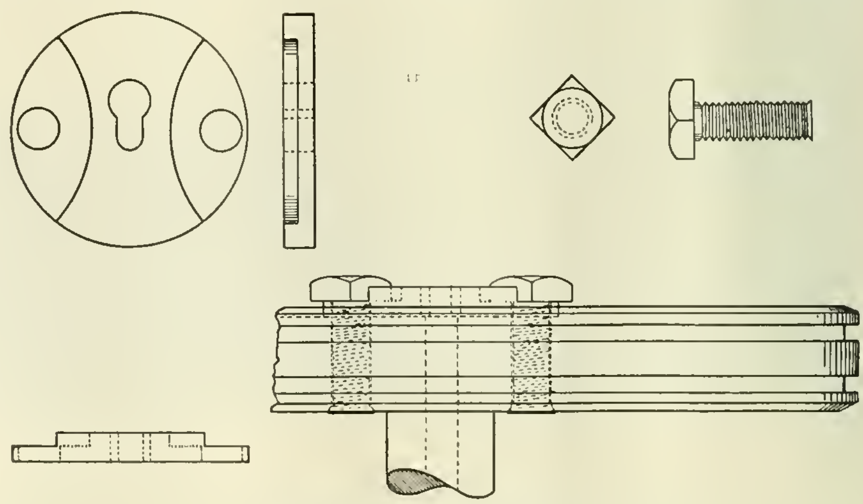


FIG. A. GREASE PRESS.

Improved Reversing Plate.

Editor:

Attached drawing shows the details of an improved method of preventing air pump failures from occuring on account of loose and broken reversing plate bolts, which frequently occurs when the original ⅜-inch bolts are in use, and which are tapped with the head, and in our past experience were often breaking. The method shown in the drawing makes use of ½-inch bolts, which reach through the head and are riveted over on the bottom, and forms a very solid and durable method of construction. The plates are counterbored, four at a time, by being held in a jig, the jig being securely bolted to the face plate of a lathe. The points of the bolts are drilled so as to afford a ready means of riveting and filling the counterbore referred to. Since adopting this method of securing the reversing plate we have been free from the old troubles.



IMPROVED REVERSING PLATE.

Chas. Markel,

Shop Foreman, C. & N. W. Ry.

Clinton, Iowa.

Sand Pipes.

Editor:

In regard to use of sand on locomotives it is something which is either not thoroughly understood by the parties that design the engines, or does not receive the attention which it deserves. There seems to be no clear understanding of what takes place after the sand leaves the box, as by measurement I find that numbers of engines have sand pipes which point directly to the rail at right angles and deliver the sand at a distance of 8 ins. to 16 ins. from the point where the leading wheel tire touches the rail, and such pipes are almost utterly useless when the locomotive is moving at less than 12 to 15 miles, and sand will not remain on rail (except in very small quantities), vibrating under the heavy load to which it is subjected by the present-day locomotive. Now, the sand is started from the box by air under a high pressure and, assisted by gravity for a distance varying

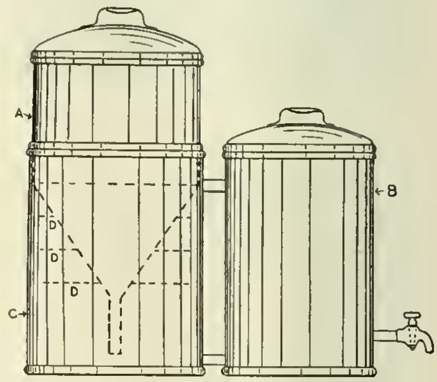


FIG. B. OIL FILLER.

from 8 ft. to 12 ft., strikes the rail so far ahead of the driver and with such violence that there is little left for the purpose of increasing the adhesion of the engine as, theoretically, the factor of adhesion may be sufficiently high for the modern locomotive just out of the works; but as the pounds about the engine develop and the tires chill from slipping, it

becomes almost impossible to handle a tonnage train over the ordinary division even with good rail conditions, with one box of sand and not break the train in two. I would suggest that the sand be closely looked after as to quality, and that engine be equipped with pipes bent parallel with rails and delivering the sand ¾-in. pipes to the point where rail and tire come in contact.

C. D. SMOOT,
Russell, Ky. C. & O. Railway.

James J. Hill on Railroad Problems.

The present condition of railway property in the United States is very serious, according to views expressed by James J. Hill in the New York *Sun*. He says they are on the brink, and then compares railroads to a bottle which has grown and grown without any enlargement being made on the neck.

What railroads and the public are suffering from is the want of proper terminal facilities. Railroad terminals can be compared with harbors. They are actually the most valuable harbors used by national commerce. The nation furnishes money to provide adequate harbors on the Great Lakes and on the seaboard. The railroads do not ask that the government furnish the money for their terminals, notwithstanding such places are vastly essential to the movement of trade. What the railroads do ask is that the nation shall smooth the way and make easy the task of those whose business it is to provide necessary terminals.

The cost of congesting railroad traffic is tremendous. When traffic is blocked and cars, unable to move are lying in railroad yards the railroads lose a portion of their earnings. The business man loses a larger share of his trade. Often the workingman loses his employment. Industry cannot do any more than crawl along on the edge of salvation when railroad channels are blocked.

Give us a big crop or a revival of business and the railroads congest. Instantly the public assumes that if enough cars can be moved on schedule time from one point to another the railroads' trouble is at an end. That is wrong. Railroads need greater movement of cars. Do you know that the average movement of a freight car is about twenty-four miles or two hours a day? Most of the time lost is consumed at terminal points where there is not enough room to handle the traffic. Bring more cars into use and you swell instead of reduce the trouble. Think what would happen to any other business if it lost the use of its machine plant for twenty-two hours out of the twenty-four! That's what happens to the railroad on its freight car proposition.

In 1910 the railroads carried 1,849,906,101 tons of revenue freight. At the average load of 21.5 tons per car it would take 86,041,865 cars to move this freight. As there are about thirty such terminals through which these cars must move we have made a good basis of comparison. For instance, if each car passed through one terminal only once a year (at present they pass several times), 7,858 cars would have to pass through this terminal every day in the year to move the freight. Now 5,000 cars a day are enough to choke utterly the largest terminal in this country. Tomorrow there may be worse conditions—7,858 cars, perhaps. Yes, our greatest menace is the crippling congestion.

So the only solution of our railroad problem is to enlarge the terminals, and that is a question of money—a vital question for the railroads today. Every thinking railroad man in the country is wondering if his line will be free to attempt this tremendous task under such conditions as will make it a feasible thing and not a miracle.

During the first seven months of 1912 the operating revenues of our railroads increased 3.3 per cent., as compared with the same period in 1911. At the same time operating expenses increased 4.9 per cent. So the net operating revenue of the railroads actually decreased in the last year .5 per cent. Also when additions to taxes and other incidental expenses become known the revenue will fall off still further. Under the existing method of rate regulation the decline in net earnings of our railroads is assured.

It is not very hard to see why the railroads are not having an easy time obtaining money. The properties of many systems are already encumbered to the limit of credit and solvency. Ten or fifteen years ago 4 per cent. would bring in capital for railroad improvements. Today some of our strongest roads must pay 4½ per cent. for new capital. With roads not so well known the rate has advanced 2 per cent. in little more than ten years. The great sum that the railroads need today can only be had on condition that the new capital is absolutely secure. Railroads can pay money only as they are permitted to earn it. Today they are on the brink. It is up to the nation to suffer the consequences if the railroads are not allowed to work out their own salvation. They alone can do it.

Coal Production.

Austria-Hungary is the fourth largest coal producing country in the world, yet three States of the United States are larger producers. Austria-Hungary mined 53,600,000 tons of coal in 1910, but this was less than one-fourth of Pennsylvania's production for 1911, and West Virginia produced nearly 60,000,000 and Illinois 53,680,000 tons. Two counties alone in Pennsylvania—Fayette and Westmoreland, produced more than 50,000,000 short tons of bituminous coal, and two others, Lackawanna and Luzerne, produced more than 51,000,000 long tons of anthracite.

Jobs for Engineers.

The United States Civil Service Commission announces an open competitive examination for engineer, sawyer and general mechanic, for men only, on February 5, at the Custom House, New York. From the register of eligibles resulting from this examination certification will be made to fill a vacancy in this position at $1,200 a year in the Indian Service at Fort Belknap Agency, Montana.

The appointee to this position will be required to operate a steam sawmill in the manufacture of ordinary lumber; to scale and mark timber for cutting; to run a traction engine and threshing outfit, and to make necessary repairs to the machinery.

Competitors will be examined in the following subjects: Practical questions, experience in handling steam engines and boilers and pumps, experience and qualifications as sawyer, experience and qualifications as general mechanic.

High Food Prices.

In discussing the high cost of living, don't forget Iquitos. That town is in the heart of the great rubber district of the upper Amazon valley. It is a Peruvian city, though its shipments of rubber go to the outside world through the entire width of Brazil to the Atlantic, 2,500 miles distant. When steamers from Europe, Argentina or North America are delayed in coming up the river, flour sometimes sells at $25 to $30 a barrel, and mutton is usually about 50 cents a pound, in United States money. Veal brings the same price, but beef sells at 35 cents. Potatoes are about $8 a bushel, butter 60 cents a pound and sugar 14 cents. Eggs sell at $1.20 a dozen, or 10 cents apiece, and fresh milk is worth 85 cents a pint. Ice is sold at 5 cents a pound and beer 50 cents a bottle. It costs 6 cents to have a collar washed, and 25 cents for a shirt.

Why Dentists Use Gold.

Many people wonder why gold is used for stopping, and are apt to credit the dentist with employing it for his own ends, on the ground that he can charge more and get correspondingly larger profits than would be the case if he used any baser and less expensive metal. But the suspicious ones may be reassured that there is no ground whatever for such ideas, and that the real reason for using gold is that it will weld while cold, and will successfully resist the action of the acids and fluids of the mouth, hence it is unequalled as a preservative for the teeth.

4-6-0 Type Locomotives for the Central Railroad of New Jersey

For many years the ten-wheeled or 4-6-0 type of locomotive has been popular for fast freight service, and has proved an efficient and reliable type of power, especially on lines having moderate grades. It is now being superseded, on a number of roads, by the Pacific type, which has greater relative steaming capacity, and is better suited to the use of high volatile coal because of the ample furnace depth and volume which can be provided. Where anthracite is used as fuel, however, an exceptionally deep furnace is not essential to complete combustion. The grate can then be placed above the driving wheels, and the use of trailing wheels avoided without materially reducing the steaming capacity of the locomotive. For this reason the ten-wheeled type is proving efficient in high-duty service, both freight and passenger, on the anthracite roads.

The Central Railroad of New Jersey has recently received from The Baldwin Locomotive Works, ten locomotives of the 4-6-0 type which are excellent examples of a design suitable for either freight or passenger service. These engines burn fine anthracite and have boilers of the modified Wootten type. The driving wheels are 69 ins. in diameter, thus giving them good speed capacity; and with a tractive force of 36,500 lbs. they are capable of handling heavy trains. They are equipped with Schmidt superheaters and outside steam pipes.

The grate is composed of water-tubes and rocking bars, and has an area of 81.6 sq. ft. Firing is accomplished through two circular doors, which are 16 ins. in diameter and placed with their centers 38 ins. apart. The firebox is built with a short combination chamber or D-head. The throat is necessarily shallow, and the D-head protects the tube ends from extreme changes of temperature. The forward end of the firebox crown is supported by three rows of expansion stays, and flexible stay-bolts are freely used, as 883 are distributed in the sides, throat and back-head.

The steam distribution is controlled by 13-in. piston valves which are driven by Walschaerts gear and are set with a lead of 1/4 in. As these locomotives will be used chiefly on level districts where comparatively little drifting is done, no by-pass valves are applied to the cylinders.

TEN-WHEEL 4-6-0 TYPE LOCOMOTIVES FOR THE CENTRAL RAILROAD OF NEW JERSEY.
C. E. Chambers, Supt. Motive Power. Baldwin Locomotive Works, Builders.

The frames are of cast steel, 5 ins. in width. Each frame is made in one piece, and the transverse bracing is most substantial. The main and side rods are of forged vanadium steel.

These locomotives are fitted with steam heat and air signal equipment, so that they can be used in passenger service when necessary. They are an interesting example of a "combination locomotive," suitable for general road service.

The principal dimensions are as follows:

Gauge—4 ft. 8½ ins.

Cylinders—23 ins. x 28 ins.

Valves—Balanced piston.

Bolier—Type, Wootten, Wagon-top; material, steel; diameter, 74 ins.; thickness of sheets, 13-16 ins. x 7/8 ins.; working pressure, 200 lbs.; fuel, fine anthracite; staying, Radial.

Firebox — Material, steel; length, 122 1/8 ins.; width, 96¼ ins.; depth, front, 64½ ins.; depth, back, 52½ ins.; thickness of sheets: sides, 3/8 ins.; back, 3/8 ins.; crown, 3/8 ins.; tube, 5/8 ins.

Water Space—Front, 4 ins.; sides, 4 ins.; back, 4 ins.

Tubes—

Material	Iron	Iron
Thickness	No. 9 W.G.	No. 12 W.G.
Number	30	210
Diameter	5 3/8 ins.	2 ins.
Length	13ft. 10¼in.	13ft. 10¼in.

Heating Surface—Firebox, 190 sq. ft.; combustion chamber, 19 sq. ft.; tubes, 2095 sq. ft.; total, 2304 sq. ft.; grate area, 81.6 sq. ft.

Driving Wheels—Diameter, outside, 69 ins.; diameter, center, 62 ins.; journals, main, 10 ins. x 12 ins.; journals, others, 9½ ins. x 12 ins.

Engine Truck Wheels—Diameter, 36 ins.; journals, 6 ins. x 12 ins.

Wheel Base—Driving, 13 ft. 6 ins.; rigid, 13 ft. 6 ins.; total engine, 25 ft. 2 ins.; total engine and tender, 55 ft. 11 3/8 ins.

Weight—On driving wheels, 166,000 lbs.; on truck, front, 51,500 lbs.; total engine, 217,500 lbs.; total engine and tender, 360,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 36 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7500 gals.; fuel, 12 tons; service, freight.

Engine equipped with Schmidt superheater.

Superheating surface, 477 sq. ft.

General Foremen's Department

International Railway General Foremen's Association.

At a joint meeting of the Executive Committees of the International General Foremen's Association, the Toolroom Foremen and the Supply-men's Association, held at the Sherman House, Chicago, last month, it was decided to hold the next convention of the General Foremen's Association in Chicago, Ill., July 15-18, 1913, at the Sherman House.

Several of the most prominent men in the railroad world are to be invited to address the meetings on some subject of special interest. It will be noted that the convention will be held one week earlier than last year. This is for the purpose of accommodating the Supply-men's Association, as it has been arranged that the Toolroom Foremen are to meet the following week, while the exhibits are still in place.

The subjects to be discussed at the General Foremen's Convention as announced in our pages last month, are of more than usual importance, and a very interesting convention is expected.

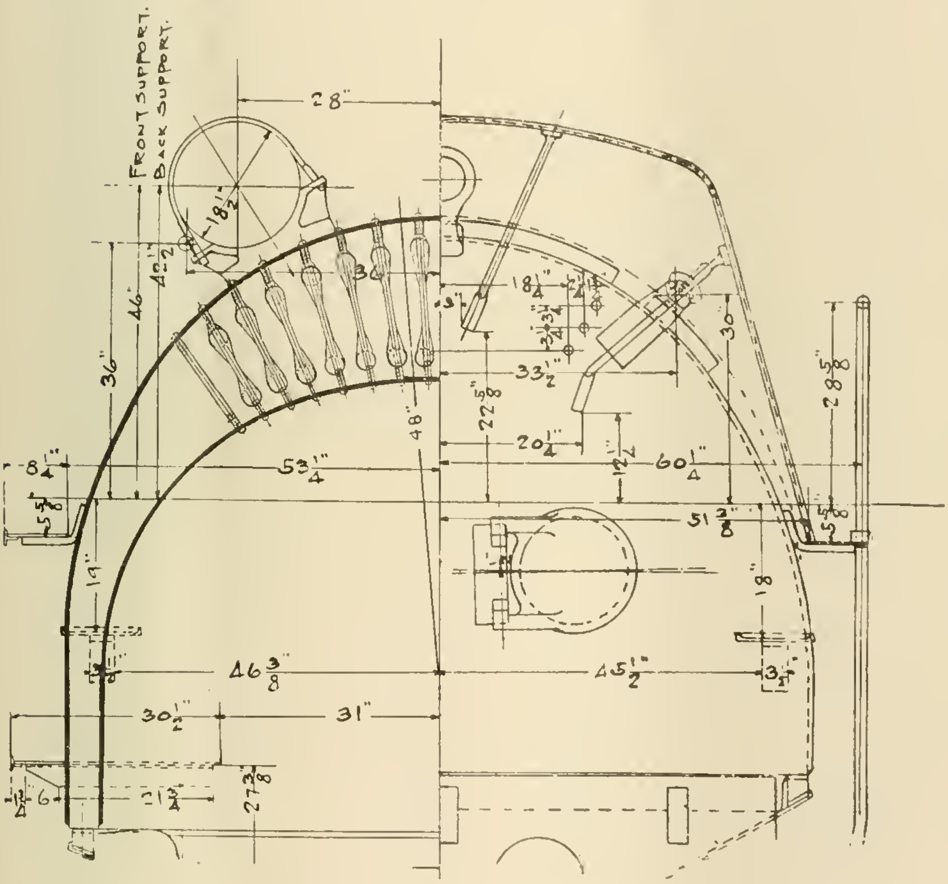
Markel's Devices.

Our readers will be glad to learn that several of Mr. Charles Markel's clever devices are coming into service on several of the Western roads. Indeed, many of his inventions have been in use for a period of years, but the present year sees a larger instalment of some of his more important improvements on locomotives. Among others the C. & N. W. Ry. are having built at the Baldwin Locomotive Works 29 switch engines which will be fully equipped with the Markel Removable Driving Box Brasses, Flangeless Shoes and Wedges, Removable Lateral Motion Plates on driving boxes and Solid End Main Rod. The same company are also building 5 switch engines for the C., St. P., M. & O. Ry. that are completely equipped with the Markel devices. They are 0-6-0 type 18 in. x 24 in. stroke, superheater, 170 lbs. pressure.

The American Locomotive Co. are building for the C. & N. W. Ry. all of which will be equipped with the Markel devices, including Lateral Motion Plates on engine truck and trailer boxes. All driving boxes on this lot of engines will have Removable Brasses except the main, which will be the American Locomotive Co.'s long bearing boxes. This lot of engines will consist of four 4-6-2 type 22 by 26-in. cylinders; seven 4-6-2 type 25 by 26-in. cylinders; forty-five 2-8-0 type 25 by 32-in. cylinders, and fifteen of the 2-8-2 type 27 by 32-in. cylinders. These locomotives will all be equipped with superheating appliances, with steam pressures varying from 170 to 180 lbs.

The American Locomotive Co. are also building for the C., St. P., M. & O. Ry. all of which will be equipped with the Markel devices. These embrace five locomotives of the 4-6-2 type with cylinders 25 by 28 ins.; five 2-8-0 type, cylinders 25 by 32 ins., and ten of the 2-8-2 type, cylinders 27 by 32 ins.

These devices are now standard on the C. & N. W. Ry. and are developing fast on other railways. They are handled by The Locomotive Improvement Company, Clinton, Iowa. It may be added that Mr. Markel has been employed for a number of years as shop foreman at the C. & N. W. Railway shops at Clinton, Iowa.



BOILER SECTION FOR LOCOMOTIVES ON CENTRAL R. R. OF NEW JERSEY.

Cutting the Rust from Bolt Threads.

If the threads on a bolt or nut are covered with rust, or fit tightly, clean them out with a mixture made as follows: Mix some powdered emery with any kind of grease and smear the threaded parts both inside of the nut and on the bolt, then turn the nut on the bolt and run it back and foth over the threads. This method will be found effective even in the most stubborn cases.

Filing Soft Metals.

It is well known to mechanics that when lead, tin, soft solder or aluminum are filed, the file is soon filled with the metal and it will not cut. It cannot be cleaned like the wood rasp by dipping it into hot water or pouring boiling water over it, but if the file and the work are kept wet with water, there will be no trouble whatever. Both file and work must be kept thoroughly wet at all times.

Catechism of Railroad Operation

Questions and Answers. Second Series.

(*Continued from page 444.*)

Q. 1. (a) What are the necessary duties of an engineer before attaching his engine to the train?

(b) What precaution should be taken if any work or repairs have been made, such as valves faced, brasses filed, etc.?

(c) Why is it bad practice to disturb the waste on driving boxes while oiling round?

(d) Why should the sand from both sand pipes strike the rail?

Ans. (a) The engineer should arrive at the roundhouse in ample time. He should first inspect the bulletin board and work report. Compare his watch with the standard clock. He should then see what fireman and engine he is going to get. On arriving at the engine he should try the gauge cocks and water glass, blow them out and see that they are working properly and register the proper water level. He should then inspect the firebox, tubes, sheets and crown-bolts, make sure that they are in proper condition. The lubricator should then be filled and the pump started as soon as possible, so that an air pressure can be obtained in order to test the brakes. While charging up his engine he should note as to whether the pump charges the engine in the proper time. Also while the air pressure is charging up he should proceed to oil the engine, and while oiling around he should inspect all parts of the engine, such as springs, hangers, equalizers, sharp flanges, loose tires, loose nuts and bolts, eccentric straps and rods. He should also try all set screws, see that all oil holes are open, paying close attention to steps, grab irons, draw bars, hose and connecting rods on both front end and back end of engine and tender. This inspection should be made as soon as possible in order that any repairs necessary can be made with as little delay as possible. Both injectors should then be tried with full steam pressure if possible. When the air-brake equipment is charged up see that all parts are drained and blown out, then try the brakes, noting the piston travel and as to whether they remain applied the proper length of time. See that the pump governor, brake valves and feed valves, air gauges are all working properly. Test the bell ringer, sand blowers and air door device, examine head light and signal lamps, see that the necessary supplies are on the engine for making the trip, also the necessary blocking and tools for disconnecting in case of breakdowns. If the engine has to be taken out of the roundhouse he should see that there is no obstruction around the wheels or guides, move the lever back and forth in order to make sure that there is no obstruction in the links, should see that the roundhouse jacks are up, doors open and turntables set and ring bell before moving the engine. When outdoors he should see that he has a sufficient amount of sand, water and coal, and that the ash pans and grates are in proper condition before leaving the track. It is also the duty of the engineer to supply himself with the latest time card before leaving the terminal.

(b) Where valves have been faced it is the duty of the engineer to admit steam to the steam chest in order to test the joints and see that there are no steam leaks, he should also move the reverse lever back and forth in order to satisfy himself that there is no obstruction in the steam chest. It is advisable also to open the auxiliary oiler at the lubricator and back steam up from the steam chest in order to ascertain that oil can pass down freely to the steam chest. A liberal supply of oil should be given that valve for a short time, where brasses have been filed the engineer should see that it is properly keyed, see that the set screws are properly tightened and that it is getting the proper lubrication, and watch it closely until he is satisfied that it is going to run all right.

(c) Disturbing the waste on driving boxes while oiling around oft permits cinders or dirt to get down into the oil holes, also disturbs the oil channels.

(d) In the event of sand being permitted to strike one rail only the drivers are liable to slip, catching on sand on one side is liable to bend rods, break pins and do damage to the engine in general.

Q. 2. Explain how you would adjust grease cups to get the best results and effect the greatest economy in the use of grease?

Ans. The rod should first be moved laterly on the pin, then screw down the grease cup until you find it commencing to bind on the pin.

Q. 3. Explain the principle upon which injectors work. Should your injectors stop working on the road, what would you do?

Ans. An injector is an apparatus in which the force of a jet of steam is transferred to a more slowly moving body of water, resulting in a final velocity sufficient to overcome the pressure from the boiler. In starting the injector the primer valve is first opened, which permits a small volume of steam to flow through the priming tube and out through the overflow pipe to the atmosphere. In some makes of injectors the waste water and steam have to pass up and out through the overflow valve before reaching the overflow nozzle, while in others, such as the screw monitor, the steam can pass over through a small tube into the overflow nozzle without passing up through the overflow valve. The steam flowing through the injector creates a partial vacuum in the injector, when the atmospheric pressure above the water in the tank forces the water up to the injector, whence it flows out through the overflow nozzle to the atmosphere. The injector is then safe to be primed. The steam valve is then opened, the increased volume of steam coming into contact with the water adds sufficient surplus velocity to the water to overcome the boiler pressure, thus forcing the water into the boiler. First learn if there is water in the tank, see that the manhole is not frozen up, that the tank valve is in proper condition; see that the tank hose is not kinked or that the lining is not collapsed, strainer stopped up, leaks between injector and tank, hot water in the suction pipe; would also note if steam was turned on properly and boiler check in proper condition, or obstruction in some of the tubes.

Q. 4. To what cause do you attribute the failure of one injector as a general thing? What would you do to obviate this failure?

Ans. One injector sometimes fails to work because it is not used often enough; to avoid this trouble both injectors should be used frequently.

Q. 5. How can a disconnected tank valve be gotten out without stopping?

Ans. By closing down the heater valve and turning steam back through the tank hose; the disconencted tank valve can sometimes be removed.

Q. 6. How can you tell the difference between a leaky injector throttle, check or primer?

Ans. A leaky boiler check usually shows steam and water at the overflow. A leaky main throttle valve or primer will show dry steam. By closing the heater valve on the screw monitor a leaky primer valve will continue to show steam at the overflow, while a leaky throttle valve will blow steam back into the tank. Closing the main steam valve at the fountain will stop the steam flowing at the overflow if the fault is in the steam valve.

Q. 7. Explain the construction and operation of a blow-off cock?

Ans. Most all blow-off cocks in use are now operated by hand. Some are in the form of gate valve and are held to their seat by steam, while others are in the form of a poppet valve. There are some automatic valves going out of use that were operated by air, acting against a large piston, which in turn operated an intermediate check and boiler check, this being operated by means of a two-way cock from the cab.

Q. 8. Describe the manner in which a sight feed lubricator operates?

Ans. The sight feed lubricator is operated by the weight of a body of water resulting from the condensation of steam, which causes the oil to pass up through the water in the sight feed glasses, where it is caught by a current of steam passing down through the equalizing tubes carrying the oil through the choke plugs into the oil pipes, where it then flows, or in some cases passes down through the steam to the steam chest by gravity.

Q. 9. (a) If the steam heat gauge showed the required pressure and the cars were not being heated properly, or the governor became inoperative, how would you proceed to locate the trouble?

(b) How does the steam heat reducing valve control the pressure?

Ans. (a) Would first observe as to whether steam was passing between rear of tender and first car, as there is a possibility of the gauge being incorrect. In the event of no steam passing back, would first inspect the steam valve at the fountain, or any other valves that might be responsible.

(b) Steam enters the reducing valve on the boiler side, passes to the back of the main steam valve, which is closed, flowing up through a small port on the boiler side of the valve over through a series of ports into the controlling valve chamber, passing up by the controlling valve, which is open, across through the body of the controlling valve and down to the top of the main steam piston, forcing it down, unseating the main steam valve, allowing steam to pass into the train line; steam from the train line side passes up through a small port to the under side of the diaphragm; when the pressure becomes greater than the tension of the regulating spring, the diaphragm moves upward; the controlling spring then seats the controlling valve, shutting off the steam from the steam piston; the steam entrapped above the piston condenses. When the steam valve spring, assisted by the steam pressure, forces the valve to its seat shutting off the steam from the train until there is a reduction under the diaphragm, when the controlling valve is again pushed downward, allowing the steam to pass to the piston as before.

Q. 10. Describe the principle of the bell ringer and how to adjust it.

Ans. The bell ringer consists of a rod connected through the bell crank with an adjusting screw connected to a small piston rod, which in turn is connected to a small piston and piston valve operating in a cylinder. Air enters through a port between the piston and valve, forcing the piston upwards. When the piston has traveled about five-eighths of an inch the adjusting screw engages the valve, moving it upward, closing the admission and opening the exhaust, when the weight of the bell pushes the piston down, also the valve opening the admission and closing the exhaust. The adjustment of the bell ringer is obtained by moving the adjusting screw at the bell or the adjusting screw between the piston and the valve inside the cylinder.

Q. 11. Explain the operation, care and defects of air sanders.

Ans. Air sanders are operated from small valves in the cab, sometimes of different construction, but the principle of all valves is to permit a small volume of air to flow down through pipes, then through small nozzles, where it comes in contact with the sand which is delivered from the sand dome down into the traps, where it is conveyed through the pipes to the rail. The usual defects of air sanders is the stopping up of the pipes down at the rail or clogging up in the traps by waste or small stones; by removing the plugs at the traps the obstruction can usually be removed, or rapping the pipes with a hammer will usually remove the wet sand at the bottom of the pipe.

Q. 12. Explain the operation, care and defects of the pneumatic air door.

Ans. When the food peddle is pressed downward the admission valve is raised from its seat, allowing air to flow in against the piston, forcing the piston to the right or downward, depending upon what class of a door it is. This piston is connected to one of the door cams, the cogs of which mash into the cogs of the opposite door cam, thus opening one door to the right and the other to the left. When the piston has traveled some distance the cushion valve is raised from its seat, admitting air to the outer end of the small piston, which acts as a cushion, preventing the doors from slamming. When the pressure is removed from the foot peddle the admission is closed and the exhaust opened, which allows the air from the large end of the piston to flow out through a restricted passageway to the atmosphere, where the air on the outer end of the small piston forces the doors to closed position. The usual causes for the door failing to operate properly are the guides being permitted to clog up with dirt or the ports or passageways stopping up, or valves sticking or improperly lubricated; cleaning and oiling properly will usually overcome the difficulty.

Q. 13. (a) Trace the steam from the boiler to the atmosphere and explain how it transmits power to the locomotive?

(b) What is superheated steam?

(c) How is it superheated, and what benefits are derived from it?

Ans. (a) The steam is generated around the direct heating surface of the boiler, rises to the steam dome when the throttle is opened, passes through the throttle valve, through the stand pipe, dry pipe, nigger head and steam pipes, through the steam passageways in the cylinder saddle, through the supply ports into the steam chest. When the valve is moved in either direction steam flows through the admission port into the cylinder, where it transmits its expansive force against the piston, which in turn is transmitted to the piston rod, cross head, main rod and crank pin. The crank pin being placed out of center of the main axle causes the wheels to revolve. The return movement of the valve allows the steam to pass out through the same admission port, through the exhaust cavity of the slide valve, through the exhaust port in the seat, exhaust pasageway in the cylinder saddle, through the exhaust stand, exhaust tip, petticoat pipe and stack to the atmosphere; with inside admission piston valves steam is admitted from the inner cavity of the valve and exhausted by the outer edge of the valve.

(b) Superheated steam is steam that has been heated to a higher temperature than the water from which it was generated.

(c) It is superheated by separating it from the water, passing it through a series of tubes and imparting more heat to it. The benefits that are derived from it are, first, it is drier and has more expansive force; that is, it can be expanded to a greater degree without any condensation resulting.

Got Her Off the Center.

To have a modern heavy locomotive operating only one side stop on the dead center is an embarrassing position. Harry Shrieve found himself in this fix one day and here is how he got out of it as explained in the *Locomotive Engineers' Monthly Journal:* I ran a 70-ton engine; broke a piston head or follower head; put engine on one side; had 28 cars in train, 950 tons. Started engine, and when she took the slack out of 24 cars she stopped on forward center and I was where I could not get a jack or perch bar; so I said to my fireman:

"Take the coal chisel and the coal pick and put the chisel under the main wheel, and hit it with the coal pick, and see if we can get her off of center."

It worked fine, started the train, and we left town.

Questions Answered

VARIATIONS IN VALVE GEAR.

238. W. B. M., Harrisburg, Pa., writes: On some of the Atlantic type of locomotives equipped with the Walschaerts valve gear we find variations in the amount of valve travel, and in other cases we find the valves perfectly square in the forward motion and defective in the backward motion. How can these defects be remedied? A.—The amount of valve travel like the amount of piston travel is part of the organic design of the engine and cannot be changed without changing the eccentric crank or oscillating link. If the valve travels too far the crank should be shortened; if the travel is not far enough the throw of the crank should be increased. Variations in the amount of lead in the forward and backward motions are owing to the location of the crank and the defect may be remedied by moving the crank to its proper position which is at right angles to the main crank. It is frequently the case that defects in the valve gearing that involves considerable reconstruction work are often tolerated when the defect may be placed on the backward motion and the forward motion may be made to be correct, and if the work of the locomotive be done almost entirely in the forward gear, the discrepancy in the back motion will not be of much consequence. It should be remembered that the length and location of the eccentric crank, and the length of the lower limb of the oscillating link should not be matters of experiment. These important details properly belong to the constructing engineers, and their attention should be called to the defects.

VELOCITY OF STEAM AND VARIATIONS IN STEAMING.

239. W. H. B., Leeds, England, writes: (1) At what velocity in feet per second would steam of 100 pounds gage pressure escape into the atmosphere, and at what velocity per second would steam at 1 pound gage pressure escape into a vacuum? (2) We have two engines here alike in all respects, except that one is fitted with the Joy valve gear with ordinary slide valves, the other is fitted with the Stephenson gear and piston valves. The former is a good steamer, while the latter steams only moderately. The slide valve engine has a louder exhaust and seems to fill the smoke stack with exhaust steam better than the piston valve engine. Both are run with reverse levers in the same position. Have the variation in the kind of valves any effect on the steaming qualities of the engines? A.(1) The velocity with which steam of any given pressure passes into the atmosphere may be calculated on the well known ratio that 1 pound of pressure represents a column of water 2.3 feet high. At that pressure above the atmosphere, 1 pound of steam occupies 1,008 times the volume of a pound of water. The formula is as follows: 2.3 x 100 = 230 x 1,008 = 231, 840, the height of the column of steam. Then the square root of 231,840 being about 481.5 multiply this root by 8 =3,852 the velocity in feet per second of steam of the pressure given. It may be stated briefly that the velocity of the flow of steam depends directly upon its pressure, and is the same as the velocity of a body falling from a height equal to a column of steam represented by the steam pressure. In regard to steam flowing into a vacuum the velocity is constant at all pressures. (2) The kinds of valve gearings referred to have little or no appreciable variable effect on the steaming qualities of the engines. If the ports or openings from the cylinders to the exhaust pipe are variable, the effect on the exhaust will be variable, and if the exhaust is such that it is hindered in its progress towards the smoke stack the effect upon the fuel combustion will be readily recognized by any one familiar with firing. Variations should also be looked for in the smokebox appliances, but the variation is more likely to be in the amount of opening between the cylinders and exhaust pipe.

UNEQUAL FLANGE WEAR.

240. R. W. F., Marianna, Fla., writes: We have a ten-wheel engine that runs to one side, but is otherwise in perfect condition. The flanges do not last any time on one side, while on the opposite side the wear is hardly noticeable. In curving the front flange on the right wheel does not touch the rail. The engine truck also runs entirely to the same side as the engine. Where should we look for the trouble? A.—If the engine is perfectly level look for the trouble in the center casting and other attachments of the front truck. The rear truck, if any, should also be examined carefully. Long straightedges should be placed along the inside of the frames, if possible, and it will likely be found that there is some variation in the truck attachments. Also note that the bearing between the saddle and truck is perfectly level, as the castings are usually rough and the tendency to bevels in rough castings or forgings is very great. It may be added that it is hard to decide on a defect of this kind without an opportunity of examining many details. Driving box saddles and spring hangers should all be examined. The pernicious effects of bevel bearings are sometimes almost past finding out. Give a couple of expert mechanics time and tools and they will find out something not visible to the eye of faith.

CIVIL SERVICE.

241. W. T. M., Brooklyn, N. Y., writes: In your January issue you stated that interested persons should write to the Civil Service Commission for Form 376, in regard to railway men wanted. Where is this commission at present? A.—The main office is at Washington, D. C., and letters addressed to the commission there will be promptly replied to. We may add that information in regard to all offices under the Federal government may be had from the commission at Washington. information in regard to State offices may be had from the various State civil commissions at the capitols of the various States, while applicants for employment in the municipalities should apply to the Civil Service Commission of the particular city where they are located. We have had a large number of inquiries in regard to the above subject, and we are pleased to repeat what we already stated, that all of the Federal boiler inspectors so far appointed are railway men.

WATER AND STEAM PRESSURES.

242. J. P. H. E., Macon, Ga., writes: Would there be any difference in the power, if you tap a cylinder and make a pipe attachment to the boiler above the water level to dry steam and the other end below the water line and have water pressure on one side of the piston and steam on the other side, both pipes being equal in size? If either side has a controlling pressure, which side would it be? A.—There would be no difference in the matter of pressure, but if the piston were disconnected the tendency of the water to rise to its own level would eventually, on account of being heavier than an equal bulk of steam, find its way to the boiler. It would depend upon whether the weight of water in the small pipe and cylinder would be sufficient to overcome the inertia of the piston. The question is an academic one, and it would be speedily found that in practice an attempt to run an engine by water at a high pressure or by steam at a high pressure, the advantage would be immensely in favor of the steam.

INCREASE IN LEAD.

243. A. S., Philadelphia, Pa., writes: Kindly advise if there is any outside valve motion of a locomotive at the present time with valve gearing that gives an increase of lead as the stroke of the valve is shortened, and is there any advantage in the increase of lead caused by the use of some kinds of valve gear? A.—There are no outside valve motions in use on American locomotives where the lead is increased, but there are a large number in Europe where the double eccentrics are in use outside of the frames of the engines and where the lead is increased as the valve stroke is shortened. The

alleged benefits of an increase of lead is an unsettled question, many eminent authorities claiming that an increase of lead is an advantage to locomotives running at high velocities, others claiming that a constant lead is preferable. The matter is very clearly discussed in "The Valve Setter's Guide."

MAKE UP TRAIN.

244. G. T. S., Three Forks, Mont., writes: Does it require any more tractive effort upon the part of the locomotive to start a train when the loaded cars in a mixed train are behind the empties, and what is the best make up of train from a brake control point of view? A. Experiments have proven that it requires more tractive effort to move the train if the loaded cars are behind than would be required if the loads were ahead.

A very successful practice in making up trains in a manner that will assist in the air brake operation is to place a number of the empties in a mixed train ahead of the loads. On a train say of 20 loads and 40 empties about 10 empties should go next to the engine, then the loaded cars followed by the remainder of the empties. While contemplating this subject of make up of train and train control, it may occur to you that if the loads are ahead and the empties in the rear, the piston travel on the loads could be taken up to about 4 inches and the travel on the empties left at about 9 and 10 inches and braking conditions would be changed, and the train could be handled similar to one of all loads or all empties.

HANDLING FREIGHT TRAINS.

245. G. T. S., Three Forks, Mont., writes: What is the probable effect of stopping long freight trains with the air brake when loaded cars are ahead and empty cars on the rear, and how should such a make up of train be handled? A. You will understand that an attempt to lay down any fixed rule for making a stop with such a make up of train at any one point would require an intimate knowledge of all the factors that enter any train stopping problem, length of train and its make up being known. Some of the principal factors are, speed, distance, grade curvature, condition of track, type of triple valve in use, amount of brake pipe leakage and length of piston travel. Even the condition of the locomotive brake enters largely into the matter, but as a general outline of the methods that should be followed in stopping a train of this kind we will disregard the unknown factors or emergency cases.

With loads ahead and empties behind, you could expect that the initial reduction would be followed by the slack running out with a tendency toward parting the train on account of the greater percentage of braking power on the empty cars, therefore you would not think of bunching the slack before the reduction but rather make the reduction before the engine throttle is closed.

The amount of the reduction should just be sufficient to go through the train, and with this kind of train should be made far enough away from the desired point of stop for this first reduction to bring the train to rest, without any additional braking power, before the maximum point of the desired stop is reached, then when within an engine length of the point at which train is going to stop, the remainder of the full service reduction should be made, the object being to bring the train to rest with the brake pipe exhaust of the brake valve open.

The intent of the light initial reduction is not to develop enough braking power in any part of the train to part it, and the second or final reduction is to build up braking power on the head end and complete the stop before its full effect can reach the rear cars or become effective upon them.

You will understand that the first reduction is to stop the train regardless of the distance, and that we consider this entirely from a damage to lading and draft gear point of view.

POSITION OF GAGE HANDS.

246. R. F. M., Buffalo, N. Y., writes: In charging a train of cars from 40 or 50 to 70 lbs. pressure, with a 9½-inch pump, and the brake valve handle in running position, the gage hands are sometimes 15 to 20 lbs. apart and often remain that way until the train is charged. Why are the pressures not equal? A. Partly because of the excess pressure or driving head required in the main reservoir to force the compressed air back into the train when charging it, and partly because of the tension of the supply valve piston spring in the feed valve.

GAGE OR FEED VALVE.

247. R. F. M., Buffalo, N. Y., writes: In pumping up the pressure on an engine with the G6 brake valve I have seen the gage hands go up together, when the handle is in running position. What causes this? A. With the feed valve of the slide valve type the pressures should rise from 7 to 12 lbs. apart if the feed valve is in an operative condition. When the gage hands go up together it indicates that the gage is not registering correctly.

FOUNDATION BRAKE GEAR.

248. T. F. L., Carbondale, Pa., writes: Could you tell me where I can find formulas for determining the length, breadth, and thickness of the levers, beams and pins in the foundation brake gear of the locomotive? A. The formulas can be found in the Proceedings of the Eighteenth Annual Convention of the Air Brake Association, which was held at Chicago in 1911. A paper presented by Mr. G. O. Hammond contains this information in detail.

AIR PUMP VALVES.

249. T. E. D., Providence, R. I. writes: (a) What lift of air valves has the 11-in. air pump?

(b) How do you obtain the lift?

(c) What are the sizes of the air valves in the cross compound pump? A.—(a) 3-32 of an inch. (b) Either by using a gauge or measuring the distance and filing the proper amount from the top of the valve. (c) The four receiving valves of the low pressure cylinder are the standard valves of the 11-in. pump, shown as No. 29177. The discharge valves of the high-pressure cylinder are of the same style but the intermediate valves are four of the standard 24396 valves of the 9½ pump.

PRESSURE IN DISTRIBUTING VALVE.

250. T. E. D., Providence, R. I. writes: How does the pressure get into chamber B on the right side of the application piston of the distributing valve? A.—If you will look into the application piston bushing or look at a diagrammatic view of the distributing valve, you will find a small port u which governs the rate of feed of brake cylinder pressure into this chamber.

To Remove Rust Stains from Clothing.

Many times when working around machinery, the clothes will come in contact with iron and get rust stains. These may be removed by using a weak solution of oxalic acid which must be applied carefully as it is highly poisonous. Sometimes the stain can be removed by washing the spot in buttermilk, in which case rubbing is necessary.

Removing Grease from Paint.

When removing grease from paint by using ordinary cleaners, the paint is liable to come off in the washing. A good and cheaply applied method is to rub the painted surface with a paste of ordinary whiting. This is allowed to dry and when it is rubbed off with a cloth the dirt and grease is taken away with it. The whiting is cheap and can be purchased at any drug store.

Aluminum Alloy.

The best all-round aluminum mixture is an alloy containing 92 per cent. of aluminum and 8 per cent. of copper. This mixture casts well, does not crystallize in service or crack in the mould, but has a fair tensile strength.

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Water.

Water is one of the most important substances used by railway companies and it costs very little, considering the valuable functions it performs. The quality of water used for steam making ought to be very carefully inspected, otherwise water may prove an expensive necessity.

Recent scientific investigations seem to indicate that hydrogen, the principal element of water, was the primary source from whence all matter originated. This hypothesis is founded upon the result of certain astronomical observations with the spectroscope, a wonderful instrument which shows the chemical composition of bodies by their rays of light. Like many other imperfectly developed truths, this theory will probably never pass beyond the stage of learned speculation. It is certain, however, that in the formation of the earth's crust, in the building up of a habitable globe, water was the principal operative agent. Other compounds were found essential for the support of life even in its lowest types or most elementary forms, but water served not only as a vital principle, it was the irresistible silent power which ground and moulded all other substances into perfect shape.

The testimony of the adamantine rocks, the records imprinted on the mountain's brow, graven on the ocean's bed, furnish a detailed history of the operations which changed the earth from the condition of an incandescent star to a solid ponderable sphere. Those who have learned to read the ancient writings on nature's walls, have their minds transported to a far away period when matter was working out its own genesis. The imagination witnesses the greatest conflict ever fought on earth. The half-molten globe is surrounded by a huge cloud of vapor which is laboring to extinguish the fiery element. A tumultuous struggle rages for countless ages. The cooling crust is continually rent asunder by spasmodic shocks tearing open immense glowing chasms and ejecting tremendous deluges of liquid lava upon the surface, as if matter was determined never to endure imprisonment. But the aqueous vapor cooling into water returns again and again to the charge, to be superheated and thrown up into space carrying away every time a portion of heat till it eventually proves conqueror by reducing the temperature of the earth's surface below the boiling point.

A true watery world follows. The earth is surrounded by a universal ocean. From pole to pole a surging muddy sea covers the whole land except where tremulous volcanic peaks rear their heads above the dreary lifeless monotony. This interminable sea has begun its solvent work upon the rocks beneath. Water in its pure state is the most universal solvent in nature. Some acids will act more vigorously on certain substances but are powerless on other bodies; while water slow in action never fails by the aid of time to dissolve every element which it encounters.

The water of the primitive seas must have been highly charged with substances which afterwards constituted the greater part of our mineral deposits—carbonic acid, silica, lime, sulphur, iron, copper, etc. This mixture probably served to accelerate the work of disintegrating the primary rocks from which subsequent strata were formed. The oldest rock known to geology, the rock which appears to rest upon the original crust of the earth, is granite. Granite is composed of quartz, mica and feldspar, and was produced from these substances by the combined action of heat, water and pressure. The vast layers of sedimentary rocks which overlie the ancient granites, and reach almost to the surface of our grass-covered prairies, have been formed by the mechanical action of water or by forms of animal life which subsisted in the ocean. Our limestones, so plentiful in the Western country, are almost entirely formed from shells, bones and corals, produced by marine animals. Such animals had the power of secreting the lime from the water in which they lived to form shells and bones. These were afterwards ground up by the action of the waves and solidified into compact rocks. In the quarries in different States fossil corals are frequently found having all the delicacy of structure of the corals taken from the reefs in course of formation near the coast of Florida; showing that the rocks beneath the soil of the fertile prairies were formed under conditions similar to what exists today at the bottom of the Atlantic ocean. Another minute marine animal or plant possessed the power of separating silica from the water, and to its tireless labors the world is indebted for most of our quartz formations. Yet another organism by its death produced an acid which collected iron that was rambling about in solution through the waters, and deposited it in beds to await resurrection at the hands of man. Many other tiny denizens of the deep labored on the building up of earth's tabernacle. The water itself acted an important part by its mechanical actions. It pounded up granite and quartz rocks, depositing the sandy product into beds which eventually hardened into sandstones; it ground up feldspar and shale producing thick banks of clay which serve as a perfect foundation for our crop-raising fields.

Advancing a few steps in geological history, steps which are long in years but short in limitless time, we perceive a vast change on the earth's surface. Upheavals have raised our continents above the waves and the waters are gathered together in their ocean beds. Life in its manifold forms has taken possession of its birthright and passed away. Nearly all the earth builders have completed their labors. The stratified rocks are arranged in perfected layers, iron and copper, and silver and gold have been stored away in their respective repositories, immense accumulations of carbon in the form of coal fill nature's capacious cellars waiting to conquer our arctic winters. All this course of gigantic production has progressed amidst an atmosphere of tropical heat and water as liquid or vapor has bound itself up in every operation.

A long lapse of ages and the earth presents a new and strange appearance. From causes not well understood, the northern part of the globe down to

about the 40° of n. l. has become an arctic region and is covered with immense masses of ice. A slow upheaval of the northern portion of this glacial area and a rise of temperature to the south results in the glaciers breaking up and moving southward, carrying with them untold loads of gravel, sand and boulders, depositing this material in most of our Northern States. The huge boulders of granite and other foreign rocks which we find scattered over our fields and glistening in our river beds were carried from the far northland in this period when water in the form of ice was first performing its architectural labors. And a wild chaotic work these ice masses performed as they moved southward slow as fate and quite as irresistible. They plowed down rocks marking the hardest material with furrows which can yet be traced in many localities: they smoothed down acclivities and filled up ancient chasms, choked river channels and scooped out new lake beds. But all this confusion was finally to result in order and a perfected habitation was to emerge from a water-washed world.

Locomotive Repairs.

A writer in the *Engineering Magazine* discussing the subject of locomotive repairs, writes as if the present system was criminally careless or needlessly negligent. The writer, like others of his kind seems to have all the requirements that are necessary to meet the situation except experience. The propositions look great—on paper. It is claimed that a locomotive now taking ten or twelve days' time to be repaired should be done in three days. When the plans are carefully analysed a whole army of clerks rise into view, and an endless chain of printed forms to be filled up come in volumes, like a circulating library. Of course, there is no mention made of what salary, if any, these clerks are to be paid, not speaking of the time that would be consumed in carefully perusing and thoughtfully digesting the detailed documents. In short, were these plans to be adopted and carried into actual practice, a machine shop would be changed into a reading room, and the handicraftsmen would become students.

The writers, of course, make no allowance for the great and growing advances already made both in means and material in nearly a century of the most remarkable progress in mechanical science in the history of the world. To their minds it seems to be all wrong. As a matter of fact it is all right. All real progress is slow. Perfection eludes and ever will elude the most earnest worker. There should be a supreme satisfaction in feeling and knowing that we are advancing in the matter of better appliances and a higher degree of skill, and that the railroads are not only keeping pace with the forward march of civilization but, in fact, are leaders in the world's work.

In the matter of general locomotive repairs it is a well known fact that the work which occupied three or four weeks thirty or forty years ago, can now be done in less than two weeks. This has not been accomplished by increasing the clerical staff, but by improvements in mechanism and the introduction of finer grades of material, particularly in tool steel, whereby higher speeds have been made possible. That progress will be continued is not to be doubted, but it is not to be expected that the progress will be so rapid. Indeed, in the very nature of things, it will be slower, as there is a limit to all things within the range of mere human accomplishment, and as we approach the summit of perfection, the steps of the climber becomes slower.

It is also a self-evident fact that all real progress in the means or methods of repair work comes from actual workers, and is largely borne in upon the minds of the workers by sheer necessity. The invention of the hydraulic jack by Richard Dudgeon is an illustration. There is no knowing how many times he may have helped in the arduous task of raising and lowering the slow moving screw jacks before the happy inspiration of applying hydrostatic pressure came to him. The idea would not likely ever have come to a writer, no matter how mercurial his mind might be in the manipulation of words and phrases. It would be interesting indeed to have some of these theoretical writers to whom we allude, put to work a few days on a well worn locomotive, or give them a turn as a blacksmith's helper, or they might try their hands at stripping a front end, or they might be asked to take down a set of wedges in a wet pit, or they might, for a change, be called out in the middle of the night to rectify the brake rigging, when the thermometer was about zero and a strong wind let loose from a glacial cave in the cruel north was whistling a tune through their petrified whiskers. Then they could give a practical illustration of scientific management, but it is more likely that they have more sense than to try a personal application of their idle theories.

Defective Parcels Post Law.

Deploring the fact that a parcels post law was passed by Congress without making provision for payment to the railroads for transporting this new class of traffic, the Committee on Railway Mail Pay today made public a statement showing arrangements in foreign countries for compensating railroads where a parcels post is now in operation.

As a basis of their claim that the railroads will be grossly underpaid under the new parcels post law, the carriers' statement says: "Under the new parcels post law, the same packages would pay the government a postage of $2.20, out of which the railroads would be paid 13 cents and the Post Office Department would retain $2.07. The railroad pay is computed on the current rate of about 8 cents per ton mile. According to the rate of 55 per cent. allowed the railways in Great Britain the railways' share of the $2.20 postage charge would be $1.21 as against only 13 cents in the United States."

Ralph Peters, President of the Long Island Railroad, is chairman on the Committee on Railway Mail Pay. The other members are: Charles A. Wickersham, president and general manager, Western Railway of Alabama; W. W. Baldwin, vice-president, Chicago, Burlington & Quincy Railroad; W. W. Atterbury, vice-president, Pennsylvania Railroad; George T. Nicholson, vice-president, Atchison, Topeka & Santa Fe Railway; E. J. Pearson, first vice-president, Missouri Pacific Railway; E. G. Buckland, vice-president, New York, New Haven & Hartford Railroad; C. F. Daly, vice-president, New York Central Lines; W. A. Worthington, assistant director of maintenance and operation of the Union & Southern Pacific Systems; W. F. Allen, secretary, and H. T. Newcomb, statistician.

The committee presents an inspiring array of facts and figures all tending to show that the compensation offered to the railroads in America is entirely inadequate to meet the service expected, and undoubtedly it only needs to be brought properly to the attention of the government that the defect will be remedied.

Making Up Time.

We have to thank several of our readers for sending to us marked papers giving accounts of public meetings of railway men, held to advocate increased safety in train operating. It is good to see public sentiment moved to promote greater safety in railway operation; but the people who can do most to make this sentiment effectual are trainmen and those in charge of signals. "Safety" first is the watchword, but we are afraid that many trainmen who subscribe to this sensible motto will not have self-denial sufficient to defy the unwritten demand of the superintendent to make time. "Make up time" is seldom a specific order to engineers of fast trains, but they all know that it is a popular practice, the making up of lost time. Many trains are too fast when run on schdule time, but there is a tendency to praise the man who exceeds that speed to make up lost time. When railway officials begin punishing men for making up time then we will conclude they mean business.

Pooling Locomotives.

The writer recently listened to a committee of engineers employed on a division of the Erie Railroad who were presenting a request to run pooled engines instead of individual engines on the grounds that they could make more pay working in the pool. This move was unexpected, but the men made good their claim that they would derive benefit from working under the system of pooling. It was the first time that we ever heard engineers maintaining that pooling was more equitable to the men than running regular engines.

The earliest record of pooling locomotives in America is that on the Richmond and Danville Railroad at the time the gauge of the North Carolina Railroad, between Richmond and Charlotte, N. C., was changed, in the latter part of March, 1875. Mr. T. M. R. Talcott, superintendent of the road, gives an account of the manner in which pooling was introduced, and of how, during the change of gauge, 36 locomotives were made to do the work of the 57 previously used for the same service. The locomotives, which were of the ten-wheel type, averaged 3.213 miles per month for a series of years—from 1872 to 1883—and the cost of locomotive repairs per mile was 2.22 cents. The pooling of locomotives is first mentioned in the report of the Railway Master Mechanics' Association in 1877, and at that time the question seems to have related rather to a greater mileage obtained by long continuous runs, made possible through relay enginemen, than the accumulation of mileage by quick turnarounds on one division, as is now generally understood by the term "pooling."

The pooling system of the Pennsylvania Road was inaugurated in 1876 by Mr. James McCrea, then superintendent of the Middle Division. Two years later Mr. McCrea introduced the same system on the New York Division of the Pennsylvania Road. Mr. McCrea writes that one of the greatest advantages claimed for this system was that the enginemen always had the same crew behind them and that they all received an equal and maximum amount of rest, and, further, that by keeping a coal account with each individual engineman they were able to decide whether it was the man or the engine that was wasting fuel. The original pooling order on the Pennsylvania Road is as follows:

"Commencing . . . . the engineers and firemen, conductors, flagmen and brakemen running extra freight on the Middle Division will be formed into crews, each crew to consist of an engineer, fireman, conductor, flagman and brakeman, and in all instructions hereafter the term 'crew' will be considered as consisting of the above-named persons. The engines will be run first in first out, except in cases where it is necessary to hold them beyond their turn for repairs. The engineer will be required to report at the end of his run all defects to the engine, and all work necessary to put her in shape for service again. The engineer will key up the main rods on the road, if necessary, but will not key up the side rods or alter them in any way. There will be a man assigned at Harrisburg and Altoona to look after the rods and wedges and keep them in good order."

The fireman was required to shovel the coal on the top of the tank down into the coal space, wipe off the back head of the boiler, sweep the footboards inside the cab and cab floor. No other cleaning was to be done by him.

With the pooling of engines it was necessary to make a change in the method of keeping the premium accounts. Previous to this accounts had been kept with the engines, and the premium divided up among the men who ran the engines.

It was now necessary to keep an individual account with the men, and, in order to do this, it was arranged that the coal should be shoveled down into the coal space as noted above, and the coal measured at the terminal, and the amount of coal left in the tank was to be marked on the back of the stub by some one assigned for this purpose.

Capital and Labor.

There is no feature of progress more exceptional in this age than the advancement in the condition of and the recognition afforded those who live by toil, and who are known as workmen; and it is safe to assert that no commercial agency or interest has done more to recognize the worth and merit of those engaged in manual employment or to improve and advance their condition, in the scale of compensation paid, in self improvement and in standing in society at large than railway companies. Manual labor is honored according to the intelligence and progressive tendency of any country. Labor of body is equally dignified with that of mind and a state is to hastening ills a prey, where sport and luxurious leisure are more popular than labor. The most certain signs of a nation's degeneracy is to find the rising generation despising labor.

Prosperity is the product of labor. It must be hewed out of the forest, plowed out of the field, blasted out of the mine, pounded out of the anvil, wrought out of the factory and furnace. Labor is at the bottom of prosperity; and the nation in which labor is the best cherished and cared for must be conspicuously progressive. Capital and labor are mutual allies, says Andrew Carnegie, and he is good authority, having figured on both sides of that fence. When hatred arises between capital and labor, capital is hoarded and hidden while labor starves.

Pride of Purely Practical Practices.

A mysterious case of loss of power happened some time ago to a locomotive on a railroad where the work of repairing was done in the good old-fashioned way, where drawings were dispensed with and approaches at accuracy were conducted on the rule of thumb system that many of our railroad men still patronize with every sign of loving kindness. The locomotive was rebuilt, and when she went out of the shop, she proved almost worthless in service compared to what she was before going into the shop. She would neither pull nor run as she was known to do previously. All sorts of theories were advanced to account for the change. Valves, pistons and exhaust passages were in succession examined, and various changes effected with no improvement. After the various changes had failed to make the engine any better, the men in charge decided that it was one of those mysterious cases of incurable perversity that sometimes seizes machinery turned out of the best-regulated shops, and that the only thing to do was to endure the change for the worse in the engine with as much fortitude as possible. Of course, all trainmen got abusing the engine, and she soon became the Ishmael of the road. Owing to the hard feeling against her and her own general worthlessness, she was kept in the round-house when not absolutely forced out by pressure of business.

One day that the foreman was complaining about the worthlessness of the engine, a machinist in the shop said he could cure her, and he was readily given permission to try. He proceeded to remove the dome cover and took out the throttle valve. Then he substituted another of ordinary design and the engine was all right.

The cause of the trouble with the engine was that the throttle valve did not admit steam properly. When the engine was undergoing the rebuilding, a new throttle valve was needed, and the pattern maker, an ordinary carpenter (the kind of a mechanic where cheap labor always proves expensive), was directed to make one. He was an enterprising mechanic, and instead of connecting the ends of the valve with ribs as usual, which leaves space to admit steam, he made the whole thing solid with the view of giving it increased strength.

It might appear curious to those not accustomed to the ways of rule-of-thumb shops that a valve made in this way should be cast, cleaned, turned, fitted and ground in without someone detecting the mistake made, but those familiar with the ways of such shops will not be surprised that the engine

was turned out with the valve in this condition.

The loss incurred by the railroad company by the inefficiency of this engine during several years of service, must have amounted to thousands of dollars. Had an indicator been applied when it was found that the engine was not working satisfactorily, the location of the defect would have been made apparent immediately. Such glaring cases of incompetency as the officers in charge of this engine displayed, are fortunately not common; but it is far too common for first-class roads to have locomotives that are not working satisfactorily, while there is no intelligent system adopted for finding the origin of the inefficiency. Examining pistons that are in perfect order, inspecting steam passages that are perfectly opened, changing valves that are properly proportioned, altering the throw of eccentrics that harmonize with the scheme of the valve motion, are lines of work adopted amidst protracted delay and serious expense as the "practical" methods of searching for a defect. The plan is about as amusing to a disinterested observer as a game of blind man's buff, which it strikingly resembles, for it is purely groping in the dark; but when a man, with knowledge which gives him a clear perception of what is really wanted, proposes to apply an indicator to the engine, he is sneered at as a theorist. There are many of our theorists much more practical than the man who makes it his boast that he is purely practical, which generally means very little, after all, as the work he can do with his hands is generally his whole capital, brain being an unknown and unnoticed quantity. If there was a little more inclination on the old-fashioned railroads to use as methods of investigation the means which scientific training has produced and less tendency to depreciate new and accurate methods, there would be reason for fewer complaints that master mechanics were degraded into mere engine house foremen. Where a man by his daily act, walk and conversation convinces all intelligent men that he is incompetent to move with the tide of progress, there is really little cause for complaint when all other officers naturally fall into the way of following the lead of his superior.

Healthy Smoke.

There is fierce agitation going on among municipalities all over the country against smoke caused by industrial plants and by locomotives that continue to burn soft coal. Within the last year many agitators against the smoke nuisance have been trying to prove that the presence of smoke is ruinous to the health of communities where it is permitted to pollute the air. Smoke is really a nuisance and its emission ought to be restrained as much as possible, for it disfigures buildings, stains the good wife's washing and poisons some vegetation; but there has never been any proof that smoke is injurious to health. When the underground railways were first put into operation in London the locomotives burned bituminous coal and the atmosphere of these tunnels was frequently stifling, but the trainmen were noted for robust health, and a belief prevailed that the smoke was wholesome. All cities noted for their smoky atmosphere are more healthy than the cleaner cities.

To Dispense with Human Skill.

Those who are familiar with pattern weaving are aware that on the Jacquard loom, perforated cards control the movements of the shuttles so that predetermined patterns are woven independently of the skill of the operator. That principle of controlling movements by perforated cards was later applied with entire success to the pianola for the production of music, and now a writer in Cassier's Magazine predicts that the same system will be applied to the working of all kinds of machine tools and even to the control of railway trains. To quote:

"The far reaching effects of the general adoption of the perforated strip for the control of machinery will be perceived as the subject is examined, in the light of results already obtained, in connection with musical instruments. The acquisition of a correct and facile technic upon such an instrument as the piano, requires intense application, and years of hard work by those who have, in the first place, a natural talent for the subject, out of all the pupils who make such studies, but few attain anything like such precision and accuracy as are given immediately to the experienced operator upon the mechanically controlled instrument. The real difference between the performance of a virtuoso and the effect of a machine appears only in such delicacies of expression as are perceptible, mainly, to the trained listener, and differences such as those are not only imperceptible, but undesirable in applying the principle to machine work.

"It follows that the development of the perforated strip to the control of machine tools may work a change in technical training and apprenticeship method, similar to that which is being effected in the subject of pianoforte instruction, leaving the education of the mechanic to be directed to those general and varied features which include the exercise of judgment and discretion, rather than of detailed and repetitive manipulation. This is entirely in accordance with the changes which have already taken place, and it is necessary only to look back over the development of the machinist's trade to perceive the manner in which the once important operators of chasing, filing, chipping, etc., have been replaced by the work of the slide rest, the grinding machine, the shaper and the drop-press.

"Not only in the control of machining work, but also in the direction of larger operations, may the possibilities of the perforated strip be indicated. With the introduction of electric propulsion upon railways, it may become practicable to have the trains controlled wholly from fixed stations, the motors responding entirely to the movement of the strip through a transmitting mechanism. Thus the position of a train upon a section might be made to correspond at all times to the relative positions of its controlling strip, the control, both as to position and rate of speed, being always kept in the hands of the operator at the fixed station, himself continually in possession of information about all other trains upon the division. Wherever a wire can be run such a control may be extended so that operations at points far distant might be synchronized in accordance with any desired plan."

University Experts Failed to Prevent Smoke.

The smoke nuisance appears to harrow the minds of people abroad as much as it does in the United States. We learn from the London *Times* that Professor Burstall, of Birmingham University, appeared in a Police Court to answer a complaint against the University for failing to consume its own smoke. He said that the university had spent an enormous amount of time and money in testing smoke preventing appliances, but with all of them smoke was produced under certain conditions. The greater portion of the coal used in this country was bituminous, and though, if the boilers were lightly worked the smoke was consumed, if they had to be forced occasionally to give a larger supply of steam on cold days, there was no appliance which would prevent them from giving black smoke. The solution was to try a type of coal which did not give smoke, as in Germany, but in this country that solution was economically unsound.

Similar experience is met with all the time in operating locomotives. It is easy preventing smoke when an engine is working light, but when it is necessary to put her in the corner to climb a steep grade or to start a heavy train no man born of woman can prevent the emission of smoke. It is wise to bear patiently with evils that are in the very nature of things, inevitable.

Air Brake Department

The Eames Brake.

It is possible that a great many of our readers have heard of the Eames Vacuum Brake, but have never seen it or heard a description of the brake.

We have secured several cuts of the operating valves and a view of the general arrangement which are shown as the Eames brake valve, the ejector for the Eames vacuum brake and the Eames driver brake.

The power of the brake is obtained from atmospheric pressure acting upon the exterior of rubber diaphragms which are forced into an iron shell when a vacuum is produced within, thus the force is transmitted to the brake shoes in a similar manner to that used in air brake practice.

This brake was the most formidable rival of the air brake and it is still used to a certain extent in foreign countries.

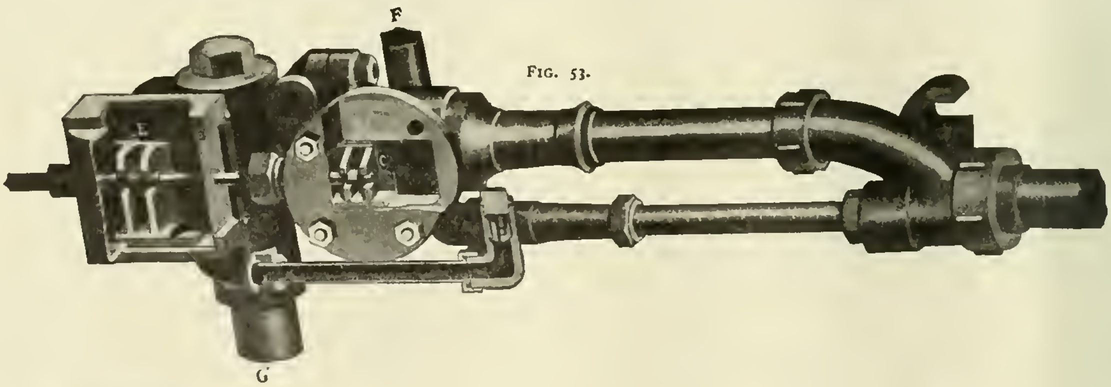


Fig. 53.

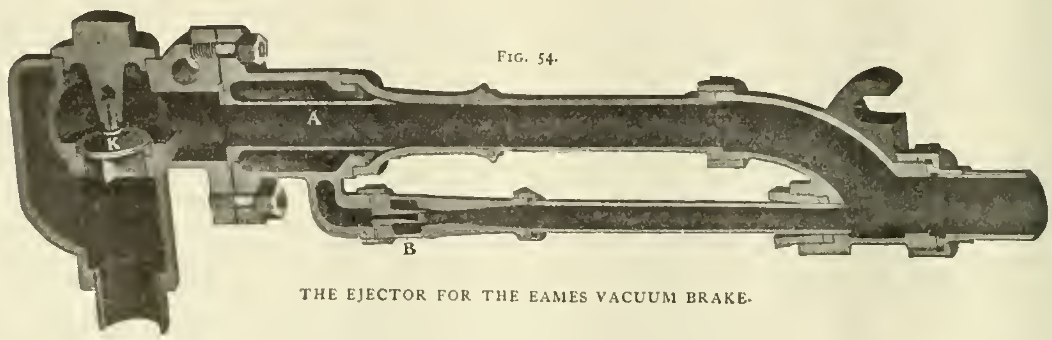


Fig. 54.

THE EJECTOR FOR THE EAMES VACUUM BRAKE.

Electrically Operated Air Brakes.

Before touching upon the subject of electric operation for compressed air brakes, we wish to say to our readers that if there is no demand for any new device in mechanical lines, there are not likely to be any invented, at least none of any great value, unless there is something seriously wrong with the law of supply and demand. Still, a man with plenty of spare time and financial resources may invent something for which there has been no demand, but in the manufacture of air brake apparatus there must be a demand for some added feature or a necessity therefor, before any attempt would be made to design and perfect a brake and possibly find that no one had any use for it. It cost the Westinghouse Air Brake Co. about $100,000 to develop the type K triple valve to its present state of efficiency, but there was a very active demand for it even if some railroad men were a trifle slow to see it.

One of the first railroads to demand something in the way of air brake that would operate quicker than a wave could travel through the brake pipe of 8 or 10 cars, or rather something that could make a brake pipe reduction on the 10th car as quickly as it could be made on the first one, was the Interborough Rapid Transit Co. of New York.

In order to handle an increased traffic condition, trains became more frequent and as over one million passengers are transported daily, it is necessary to run trains of 9 and 10 cars at speeds as high as 40 miles per hour on a headway of 90 seconds. It was obvious that if schedules were to be maintained on these trains, that is, if the train was to be stopped, passengers discharged and received, and the train again started without delaying the following train which was as stated, 90 seconds later on the schedule, a higher rate of acceleration and retardation was imperative. To bring the rate of acceleration as nearly as possible to the desired point, improved motive power was installed and with it the rate of acceleration increased to a figure about three times that obtained with modern passenger locomotives.

It was then found that the automatic brake, even with the quick-service, graduated release and high pressure, was too slow in action to bring the rate of deceleration to the desired figure; that is, too much time was consumed in getting the brake applied, or, in other words, there was too much distance between the place of application of the brake and the point of stop. In order to meet this condition the Westinghouse Air Brake Company designed and installed a new system of air brakes. The highest order of pneumatic or compressed air brake was used and the application and release of brakes electrically transmitted to the operating valve on each car.

The success attained to a very gratifying degree to all parties concerned. The

motive power on the Interborough is, of course, electric, but at the proper time we will deal with the electrification of air brakes for steam road service.

It has long been known that electricity could add to the flexibility and efficiency of the compressed air brake, but in steam road service there were some reasons why the "Electro-Pneumatic" brake was not employed until quite recently.

One of the chief reasons is that the pneumatic brake has been sufficiently flexible to answer to the demands until quite recently, and to go back several years, the pneumatic brake had not been brought to a degree of perfection that would warrant the application of electricity. As a general thing electric current has not been available on steam locomotives and there has not been enough knowledge on the subject or material at hand to insure reliable current and connections.

Now, however, practically all first-class trains are lighted by electricity or the locomotive has some electric current and the air brake art has developed into a science, reliable information is at hand, and jumper connections have been brought to such a state of efficiency that reliable connections are easily made. The electro-pneumatic brake can now be considered a wonderful achievement in steam road service.

It will be understood that electric current does not add to, or produce any braking power, it merely transmits the intent of the engineer to every car on the train; that is, the service application takes place on each car in the train the instant the brake valve handle touches service position, thus any shocks to the train resulting from the time element are eliminated by the electric current and in emergencies the quick-action, electrically transmitted, produces an instantaneous application on all cars in the train, thereby shortening the stop as compared with that required by the pneumatic brake alone in stopping the same train.

Our air brake readers are aware of the changes made in air brake equipments during the past 15 years; in 1896 the high-speed brake came into use because the best stop that could be made from high speeds by the quick-action brake could be shortened several hundred feet by the use of the high-speed brake. About 10 years later it was found that the best stop made by the high-speed brake could be shortened several hundred feet by the L. N. equipment, and the stop was still further shortened by the use of the L. G. N. triple valve.

In 1909 the distance in which a train of modern equipment cars could be stopped from high rates of speeds had increased to such an extent that the length of stop could not be shortened to a reasonable distance by the use of any triple valve in existence, but the P. C. brake equipment again brought the length of stop from 60 mile per hour speeds to about 1100 feet.

Now as passenger trains could be stopped from 60 mile per hour speeds in less than 1100 feet in 1888, there must be some reason why the length of stop has been on a continual increase, and the reason sums up in about two causes, heavier cars and longer trains. The same thing has caused a further demand for an Electro-Pneumatic brake in steam road service.

Railroads that are still going along with the old quick-action automatic or the high-speed brake, can have no immediate use for an electric transmission because electrification will not be needed until the cars are equipped with an efficient pneumatic brake, as, for instance, a certain train running at a given speed, may be stopped by the high-speed brake in a distance of 1700 feet, an emergency application, electrically transmitted, might possibly shorten this distance 300 feet, but if the P. C. equipment was first installed, the stop would likely be shortened by 500 or 600 feet without any electric transmission.

There are quite a number of different types of electro-pneumatic brake equipments, and in many instances the pneumatic brake has been improved upon while the electric transmission was added. Some of the added features to the brake valve or operating valve are, a limiting of service brake pipe reduction in which the preliminary exhaust is cut off at the time the brake pipe pressure and service reservoir pressures have equalized. Another is the prevention of an overcharge in the equalizing reservoir by means of a collapsible equalizing piston that is, if equalizing reservoir pressure through any manipulation of the brake valve, becomes about two pounds higher in pressure than the brake pipe, the equalizing piston will collapse and allow the brake pipe and equalizing reservoir pressure to equalize. Another improvement is the prompt response of a service reduction due to a combination of direct and equalizing exhaust ports. This materially reduces the time element in obtaining a reduction with the equalizing discharge type of brake valve. However, if the electro-penumatic brake is to be used on the ordinary locomotive having the E. T. brake, about the only change in equipment that will be required is a new upper case or valve body and a new rotary valve key for the brake valve. The electric portion of the brake

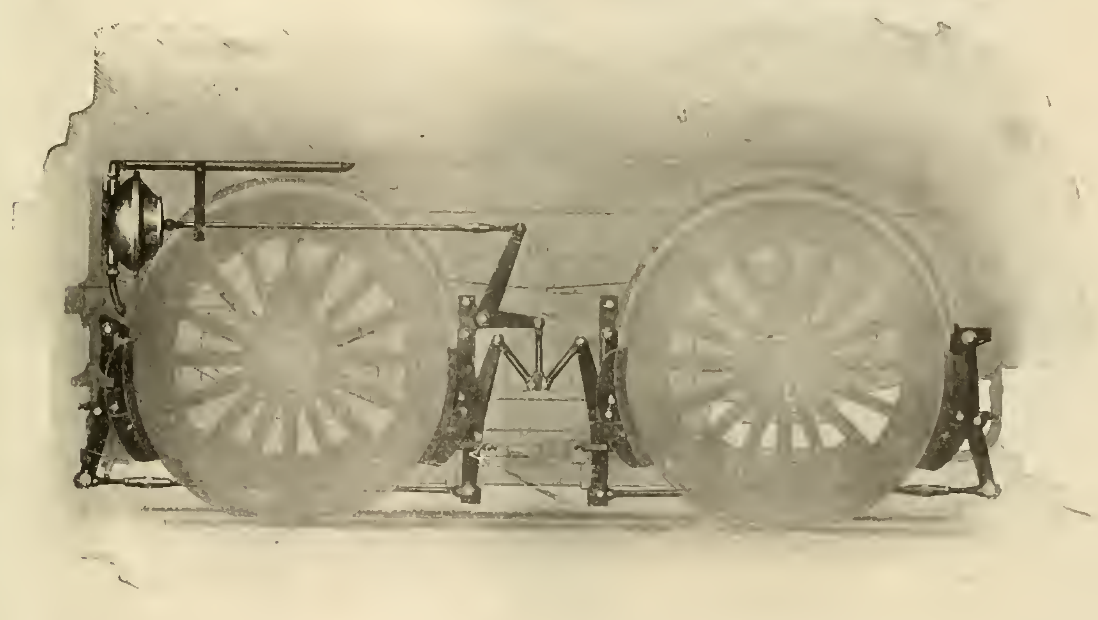


FIG. 56.—EAMES DRIVER BRAKE.

valve is in a small case located just above the automatic brake valve and is operated by the same handle and the one rotary valve key serves for both electric and pneumatic.

The distributing valve has no electric connections, it being subject to the instaneous brake pipe reduction on the cars. This slight change in the brake valve and the wiring is about all that is required on the locomotive assuming that the train is lighted with electricity.

There is one type of electro-pneumatic brake that uses a 70-lb. brake pipe pressure and develops a brake cylinder pressure of 100 lbs. and more with an emergency application and the chief features of another type are: full protection against complete loss of the brake pipe pressure from a failure on any part of the system; maximum and predetermined flexibility for service operation; certain and uniform action; predetermined and maximum practicable difference between service and emergency braking power; instaneous quick action; complete separation of service and emergency features, both electric and pneumatic; full emergency pressure obtainable at will, even after a full service application; automatic emergency when predetermined brake pipe reduction is made after equalization, or when brake pipe pressure is reduced beyond a predetermined danger point, due to leakage or other causes; brake cylinder pressure maintained in emergency, and improved graduated release feature.

Now it is evident that with the various passenger car brake equipments now in use, there should be some standard brake that will embody all of the desirable features of the present system of brakes and eliminate, so far as possible, all the undesirable and to this intent the Westinghouse Co. have perfected a new brake of a universal design.

The P. C. equipment, similar to the E. T. brake, provides one size of control valve for all sizes of brake cylinders, but it is designed for steam road service, while other control valves such as the E-11 are electrically operated.

The idea is to have one standard equipment for all classes of service as well as all sizes of brake cylinders and for any necessary number of brake cylinders to be operated both electrically or pneumatically in either steam or electric service. In perfecting this brake provisions were made to embody or eliminate any of the features we have enumerated so that any class of service can be covered and this installation can be started with a plain automatic operation or with the most efficient brake ever designed, or similarly the ordinary features of the quick-action brake can be started with and by additions and substitutions, of standard parts, it can be built up to any desired operation.

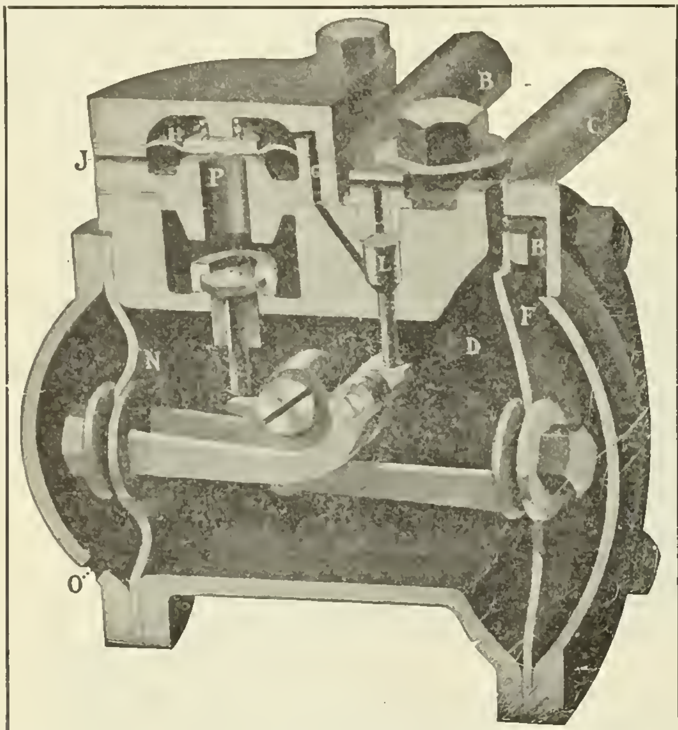


FIG. 55.—EAMES BRAKE VALVE.

By this method any feature such as graduated release or an emergency application after a predetermined service reduction can be eliminated or, in short, the brake can be transformed to meet with the ideas of any supervisor of air brakes, or any features can be reincorporated or added should he change his mind concerning any of the features.

As stated, this brake is now undergoing a thorough test in service and is the brake we hope to fully illustrate and describe as soon as the entire description is available for this purpose and there should be ample time for this as the brake equipment has not as yet received a name for reference.

Air Brake Tests.

Among many engine crews there is prevalent a general supposition that with modern locomotives and large capacity air compressors, a train of cars may be parted and the angle cock remain open on the rear portion of the cars still coupled to the locomotive, without the engineer knowing it, or without being indicated by the air gage. In past issues we have given our readers the results of some tests made for the purpose of ascertaining the outcome of trains parting under various conditions, and since that time another test, for the purpose of noting the brake action under certain conditions of an open brake pipe, has been conducted.

This train was composed of 160 cars made up on two tracks, with the rear end of the train opposite the locomotive. The locomotive was equipped with the E. T. brake, and two 11-in. air compressors. There was no selection of cars or type of triple valve, but there were eight type K valves on the head cars and some others throughout the train. Some of the observations that were made will be noted here, because they will give the reader a definite idea of the difference in air pressure that can exist between the ends of a brake pipe on a train of cars than can, and are being hauled by modern locomotives.

The first test was made to demonstrate, if possible, the ability of two 11-in. pumps to maintain maximum pressure to be shown on the air gage if the angle cock on the rear car was left open, as in the case of a parted train. The engine was coupled to the train with 110 lbs. main reservoir pressure, hose coupled up, and the angle cock at the rear end left open. The brake valve handle was left in running position and pressure reduced to 55 lbs. in the main reservoir and 35 lbs. in the brake pipe, when the pumps started to work and continued working for a period of ten minutes and no air pressure appeared at the rear end of the brake pipe. The valve handle was then moved to release position and the pressure reduced to 20 lbs., the pumps started racing and in four minutes, or 14 minutes after the test was started, the pressure was raised to 51 lbs.; in 16 minutes the engine gage showed 58 lbs., at which time air pressure showed up at the rear end. In 20 minutes the engine gage showed 62 lbs.; in 29 minutes 70 lbs.; in 33 minutes, 73 lbs.

The brake valve was then returned to running position, engine and tender brake applied immediately and the head car brakes in 20 seconds. Obviously it is impossible to haul a train and maintain brake pipe pressure at a standard with

the brake valve handle in running position if the angle cock on the rear is left open. At the return to running position, and application of the brake, an air gage was attached to the rear end of the train and the gages read, M. R. 70, B. P. 50 and gage at the rear 14 lbs.

The pump throttle was then closed and the pressure equalized throughout the train at 27 lbs.

The pumps were again started, and the pressures raised as follows:

With the above pressures the brake

In 1 min.	M. R. 102 lbs.	B. P. 50 lbs.	Gage at rear 25 lbs.
" 6 "	" 107 "	" 58 "	" " " 27 "
" 10 "	" 109 "	" 59 "	" " " 33 "
" 16 "	" 109 "	" 61 "	" " " 37 "
" 20 "	" 109 "	" 61 "	" " " 37 "
" 24 "	" 109 "	" 61 "	" " " 39 "
" 30 "	" 109 "	" 62 "	" " " 40 "
" 37 "	" 109 "	" 62 "	" " " 43 "

valve was placed in full release position, and in one minute pressures in the main reservoir and brake pipe on the engine equalized at 90 lbs. with no variation in pressure at the rear end of the brake pipe, and at the expiration of ten more minutes, engine gage registered M. R. 78, B. P. 70, and gage at rear 47 lbs., pumps working at full speed.

The time of a number of applications and releases was also noted with this train, which we will not have any particular reference to save to state that, as could be expected, all brakes could not be applied and a variety of brake cylinder pressures were obtained on those that did respond. The most satisfactory release was accomplished with the brake valve in release position from 20 to 25 seconds.

Later on the train was reduced to 104 cars and the charging time noted. The engine was coupled up with 110 lbs. main reservoir pressure and no air pressure in the train brake equipment, a gage was attached to the rear hose, the brake valve was in release position and in 60 seconds air pressure was shown at the rear end, pressures on the engine at this time were, M. R., 70 lbs.; B. P., 68 lbs.

In 4 mins.	M. R. registered 70 lbs.	B. P. 68 lbs.	rear gage 20 lbs.
" 6 "	" " 72 "	" 72 "	" " 32 "
" 12 "	" " 74 "	" 74 "	" " 45 "

Brake valve moved to running position.

" 14 "	" " 87 "	" 63 "	" " 49 "
" 18 "	" " 87 "	" 63 "	" " 50 "

At these pressures pumps slowed down and excess pressure governor top was cut out.

" 20 "	" " 104 "	" 64 "	" " 52 "
" 26 "	" " 109 "	" 67 "	" " 54 "
" 30 "	" " 110 "	" 70 "	" " 55 "
" 38 "	" " 110 "	" 70 "	" " 60 "

A number of application and release tests were then made with this train of 104 cars, an emergency application was made and the brake on the 104th car applied in 8 seconds.

A 20 lb. reduction applied the brake on the 102d car in 21 seconds. With the brake valve 25 seconds in release position before being returned to running position released all brakes in 52 seconds, the rear gage registering 50 lbs.

Another 20 lb. reduction was made after the recharge and the release made by allowing the brake valve to remain in full release but 5 seconds; it required one minute and 40 seconds to release the rear brakes, the rear gage registering but 40 lbs.

A detailed description of all tests conducted cannot be given at this time, but it is evident that with unusually long trains, a somewhat longer time in release position is necessary even with large capacity air compressors, to insure the quickest possible release of brakes.

The length of time the pumps were compelled to run in order to accumulate these pressures on the long, leaky brake pipes and the number of strokes per minute they were operating at in order to maintain the pressure is, to our mind, worthy of some serious consideration. The amount of steam consumed by simple or direct acting air pumps under such conditions should be brought to the notice of everyone who is striving for economy in coal consumption, and the economical advantages of compound compressors should be pointed out.

Trains to Speed 500 Miles an Hour.

Owing to numerous train accidents due to high speed, there has been developing a strong public sentiment in favor of slower trains, and now suddenly comes the announcement that an inventor has devised an aerial railway on which trains can be run at speeds varying from 300 to 500 miles an hour. The inventor of this speed novelty is Emile Bachelet, of Mount Vernon, N. Y.

To a *Globe* reporter the inventor explained that his plan was to erect a steel track, hardly more than a series of large wires, on poles to Boston to equip this track with a series of tubes some thirty feet long, and to run them across country at five minute intervals, with mail and express matter. He said that later special torpedo cars would be built to carry passengers, though only a few could be accommodated in each car. In the case of human traffic, he explained, the speed would necessarily be reduced to somethink like 100 to 200 miles an hour.

A five hundred pound projectile hurling 500 miles an hour across country from New York to Boston, with no contact with anything save the atmosphere, held forth visions of death and destruction if the thing should go astray. The inventor explained that this would be impossible on account of the terrific grip of the forward movement, the hold that the levitating currents maintained on the cylinder, and that in addition narrow flanges would be fitted on the bottom of the cylinder, which in emergency would drop against the track, keeping the rocketing cylinder in constant control.

He said that the car would be automatically stopped at its destination, and declared that the cost of operating the road would be but trifling.

"It is practically shooting the projectile straight into Boston," he said. "Persons along the line would be perfectly safe, as the track would be raised on poles, and it would be impossible for the car to break away from the current and go cavorting outside the zone of attraction. Persons could look up and see the great tubes whizzing like monster rifle balls above them. Even at high speed, I think, they would be visible, though blurred.

"Of course the great speed is obtained because I have succeeded in removing all friction save that with the air. In the case of a railroad train there is wheel friction on the rails, axle friction, and friction in all moving parts, which creates tremendous resistance. My levitated railway has none of this to contend with.

Postmaster General Hitchcock is reported to have sent engineers to examine this new system of rapid transit.

A Missouri representative in Congress is pushing forward a measure which proposes spending $20,000,000 on the construction of a public highway reaching from the Atlantic to the Pacific coast. We understand that some railway officials are opposing this bill which we regard as short-sighted policy. A trunk highway would promote improved branch roads which would tend to even up the freight sent to railways, and there would be no competition to speak of with rail transportation.

You are working for yourself when you hire a good man to work for you.

Electrical Department

Electric Switcher for the Spokane and Inland R. R.

The application of the electric switcher locomotive to yard service has proven reliable and economical. Many railroads have purchased electric switchers where electrification has been installed, the most important of which is the New York, New Haven and Hartford R. R., which now has in operation as many as fifteen.

The Spokane and Inland R. R. of State of Washington has recently received a Baldwin-Westinghouse electric switcher shown in our illustration The cab is located centrally, and sloping hoods are provided to give a better view when coupling and uncoupling from the cars. The motors, of which there are four each of type 301-D-2, have sufficient capacity to enable the locomotive to exert continuously a tractive effort of 9,400 lbs. It will also exert a tractive effort of 16,000 lbs. at approximately 9.2 miles per hour and on clean dry rails a momentarily maximum tractive effort of 25,000 lbs. can be obtained. The principal dimensions are: Width, 9 ft. 6 in.; height, 12 ft. 1 in.; wheel base, 22 ft. 2 in.; driving wheels, 37½ in.

ELECTRIC LOCOMOTIVE FOR THE INLAND EMPIRE SYSTEM, SPOKANE, WASH.

Storage Batteries.

In our previous articles on the electric storage battery of the lead type we have considered the types most interesting to railroad men, namely, those for car lighting and for signal operation. The construction and method of assembling were discussed and we now come to the *care* of *battery*, which applies equally well to either type.

The amount of current which can be taken out of a battery is limited, and it is therefore necessary to "charge" same at intervals. The strength or density of the electrolyte rises during charge and falls during discharge due to the chemical changes. This rise and fall in the specific gravity of the electrolyte affords a convenient means of following the operation of the battery. Proper operation is very necessary, as both over discharging and excessive overcharging are very injurious to the plates. This rise and fall can be tested by means of a hydrometer, two kinds being illustrated and described in our last issue. By choosing one cell in a battery and testing the specific gravity the condition of the whole battery is known as all of the cells rise and fall together.

On the discharge of a battery it is not advisable to allow the battery to reach a point where the lights become dim. At this point the full capacity of the battery has not been used, but it is the safe limit or working range.

Regarding the charging of the battery current should be applied as often as necessary to recharge the battery after same has been used, this charge to be of such duration, as to bring the battery back to normal full-charge condition. About once every two or three weeks an over charge should be given. By overcharge we mean that the electric current should be continued until the specific gravity does not change, at which time the cells will be "gasing," or what might be called boiling. The overcharge is for the purpose of keeping the battery in good condition and all the cells equalized.

Evaporation of the water of the electrolyte takes place causing the height of the liquid to fall, and if not brought back to the proper level the tops of the plates will be exposed to the air, which is harmful to the battery. The evaporation is replaced by adding water, and it is very essential that this be *pure* water, otherwise an impurity will get into the cells which may cause eating away of the plates and severe damage to the battery. Only enough water should be added to just cover the plates and care should be taken not to fill the cells too full.

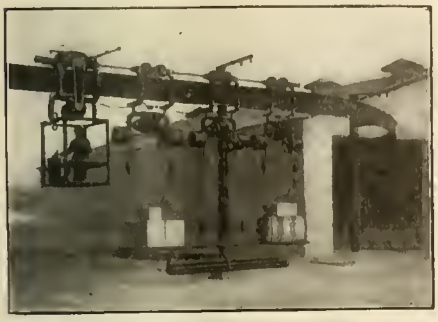
Occasionally the cells should be inspected, especially just before starting the overcharge to make sure that there are no short circuits between the plates. These short circuits may be caused by two adjacent plates actually touching or an accumulation of material lodging between them. These short circuits would be indicated by a falling off in specific gravity of a cell as compared to the other cells; or less gasing than rest of cells; or a marked difference in color of the plates as compared to the others.

There is a gradual accumulation of sediment in the bottom of the jars and under no circumstances should this be allowed to get up to the bottom of the plates, as the plates would thus become short circuited and serious injury would result. If it becomes necessary to remove this sediment, the battery should be fully charged, the plates removed from the necessary cells, the electrolyte drained off, the sediment washed out, and the plates returned to the cell as soon as possible.

It is often necessary to put a battery out of commission, and if for a period of over nine months the battery should be fully charged first. The electrolyte should then be siphoned off and each cell immediately filled with fresh, pure water. After the plates have stood in the water for at least twelve hours same can be siphoned off and battery can stand indefinitely.

Westinghouse Telpherage System.

The telphers manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, present the ideal means for handling miscellaneous packages, or what is known as less than carload lot freight, in railway freight terminals and transfer stations. These machines hoist, convey, and lower. They can be arranged to serve every point in any given space and can tier packages to a much greater height than is possible by hand. Freight can be transferred by them from one point to another without rehandling and with much greater speed and economy than can be done by cranes of any kind, motor trucks, or hand trucks.



WESTINGHOUSE TELPHERAGE SYSTEM.

The telpher train runs on an elevated single-rail track and consists of a motor-driven tractor with one, two or three trailers. Each trailer is equipped with a motor-operated hoist. The tractor motor and trailer hoist motors are controlled by an operator stationed in the cab of the tractor.

In operation, the articles to be transported are attached to the trailer hoists or are loaded on flatboards or trucks which are attached to the hoists as shown above. The load is then raised and conveyed to the desired point. A number of extra flatboards or trucks are used so that they can be loaded and unloaded without delaying the telpher.

Electricity in Excavation and Construction Work.

The General Electric Company has just issued an interesting bulletin (No. A4080) devoted to the use of "Electricity in Excavation and Construction Work." The bulletin deals with both the generating of the current and its use through motors. It touches on the advantages to be derived from the use of electric power, and refers briefly to its application to the work in connection with the Panama Canal, Catskill Aqueduct, New York Barge Canal, and in general building construction.

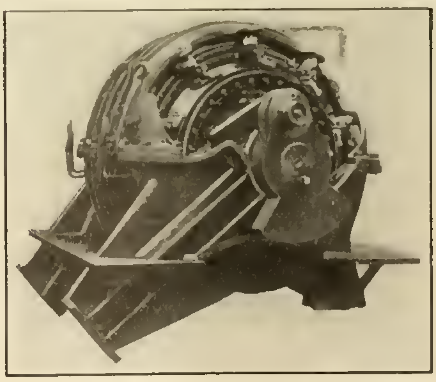
Copies of this interesting bulletin may be had on application to the company's office, Schenectady, N. Y.

Pennsylvania Electric Locomotives.

During the year ending November, 1911, thirty-three electric locomotives on the Pennsylvania Railroad operated with but thirteen minutes aggregate delay. The performance during the last year has been equally phenominal.

The large amounts of power taken by these locomotives, each of which is capable of hauling heavy trains of 800 tons at 60 m. p. h., is collected from a third rail and by means of control apparatus is conducted to two large motors, each of which is of 2,000 horsepower. These motors are the largest railway motors ever built by the Westinghouse Electric & Manufacturing Company or any other company. Our illustration shows one of these motors removed from the side frames of the locomotive. The power is transmitted to the drivers by means of connecting rods. A connecting rod runs from the crank pin, shown in the photograph, to an idle or jack shaft. A horizontal rod then connects the jack shaft to the drivers.

A great deal of talk has been heard recently regarding field control for railway motors. These large motors of the Pennsylvania electric locomotive are designed for field control. The field of each motor is divided into two parts so that full field is obtained for starting, giving large tractive power, and when higher speed is desired the field strength can be reduced.



ELECTRIC MOTOR, PENNSYLVANIA RAILROAD, NEW YORK CITY.

There are four running speeds with this locomotive approximately 10, 20, 40 and 60 m. p. h. so that this field control gives great flexibility of operation as well as a large saving in power.

The Long Island Railroad Company have recently ordered 27 equipments of multiple-unit control. These equipments are to be used in the service of the interurban trains of the L. I. R. R. from the Pennsylvania station in New York City to suburban town on Long Island. This company has already in operation 250 similar equipments.

Commutator Cement.

Folder 4247 issued by the Westinghouse Electric & Mfg. Company at East Pittsburgh covers the use of Westinghouse Commutator Cement for repairing commutators and also directions for using it. This cement is composed of liquid and powder furnished in separate vessels, and is to be mixed according to specific directions. It is said to set quickly, possess high insulation qualities, and not to be affected by expansion or contraction.

What Causes Color?

Doelter has published the results of experiments on the action of radium rays on the colors of precious stones, and those of dyed fabrics in atmospheres of oxygen and of nitrogen. The effect of hydrogen dioxide, ultra-violet rays and elevation of temperature on the color changes caused by radium was also studied. In these changes neither organic colors nor the rare earths played any considerable part, the oxides of iron, chromium and manganese being, in all probility, the principal factors. The hypothesis that the colors, like those of rock salt, are due to traces of colloidal metals, which are ionized by the radium rays, appears worthy of consideration. Most mineral dyes, however, appear to be unstable, even the suboxides.

When to Work.

If we always waited to do what ought to be done until we felt like doing it the world would come to a standstill. Spontaneous activity has an attractive sound to it, but it does not often "do things." The world's work is done by men and women who have no time to waste waiting for the "spontaneity" will-o'-the-wisp. but who must work and produce results whether they feel like it or not. The time when it has got to be done is the time to do a thing. The person who throws himself heartily into his work at such a time, in utter disregard of his feelings and inclinations, is going to do the best work then and in the long run. The person who always waits for a spontaneous, unsolicited prompting to a specific piece of work misses most of his opportunities and possibilities, and is not really a serious factor in the life of the world. Self-forced work, sternly attacked and doggedly held to, breeds power in work and liking for work. Two wait for power and inclination to come first is to try to hitch the cause to the result.

Who was Esau, asked a teacher in a Newark Sunday school, of a little boy. The prompt answer was: "Esau was the writer of a book of fables, and he sold the copyright for a mess of potash."

Dangerous Surprise Tests.

The management of the New York, New Haven & Hartford Railroad has been conspicuously under public criticism of late owing to train accidents which were due to careless methods of operating. Now the officials appear to be seized with sudden ideas of prevention and they have determined to place new and unheard-of burdens upon the trainmen, particulars of which have recently been circulated among all concerned. Surprise tests are going to be introduced on a scale never attempted before on any railroad. Mr. Warren S. Stone, grand chief of the Brotherhood of Locomotive Engineers comments in the *Locomotive Engineers' Journal* on the new system of Surprise tests and we endorse every word he writes. His letter reads:

By order of the management of the New York, New Haven & Hartford Railway their engineers will be given "Surprise Tests."

The principle of "Surprise Tests" is to test the observance of the rules of operation, and are practiced by many of the roads.

The New Haven system has gone farther than any road has gone heretofore, and some of the "tests" are so unfair, and we might add, criminal, that we publish the entire list of 30 tests. Any or all of these are liable to be sprung at any time or place on any engineer, regardless of how important the run or the time may be.

1. Torpedoes.
2. Fusees.
3. Train orders improperly made out.
4. Clearance blank improperly made out.
5. Train orders improperly repeated.
6. Automatic signals. Block signals.
7. Train order signals.
8. Distant signals.
9. Markers improperly displayed.
10. Flagman back the proper distance.
11. Wrong signal given to come in.
12. Signal whistles given by engineer.
13. Slow order observance.
14. Caution signals alongside of track.
15. Fixed signals clear with red flag in tower.
16. Lights removed from signal.
17. Blade removed from signal.
18. Signals half way between stop and clear.
19. Train order signals dropped between the engine and caboose.
20. Train order signal in "clear" position before same can be seen by engineer on sections where normal position of train order signal is "stop."
21. Cutting of engine loose for water.
22. Block signal "clear" and changed to "stop" while work is being done at stations.
23. Wrong engine number given reporting train in block.
24. Blank X-1 showing all trains had arrived when one had registered in the wrong space.
25. Observation of blue flags.
26. Starting without calling in flagman.
27. Changing switch lights to show "red" instead of "green." (Of course, the switch itself must never be changed) and this test should only be made where engineer has long view of switch light.
28. Great care must be used in making some of these tests to avoid rough handling of train or possibility of breaking trains apart, or injury to passengers.
29. Parties making the "tests" should make a report showing the nature in about the following form:
30. Train No —, Engine No. —, Date of test —, Time —. Then description of the test; for example:

"Blank X delivered without train number show crew would not accept until corrected." When tested. Discipline imposed. Name. Occupation. Discipline. Remarks. Signed by the party.

If such tests as turning switch lights "red" are to be put in practice, then the time has arrived when we should have national legislation making it a criminal offense. The strain on engineers of these fast trains is bad enough under the most favorable conditions. No one can measure the effect of such a shock on an engineer as flying through the night with a fast train and coming to some curve or obscure place, or running out of a patch of fog into a clear place to see a switch light as "red as blood" staring him in the face and the headlight shining on a string of cars or another train on a siding. A man lives years in such seconds, and will not get over the effect of it in months. It is true they issue instructions "that this test should only be made where engineer has long view of switch light," but in the West where it was put in practice a few years ago by a road, it was only a few months until local officials were selecting the worst places they could find to make the tests. After two employees had been injured by jumping off it was discontinued and we are surprised to see it come up again.

They instruct that great care must be taken in making some of the tests to avoid rough handling of the trains, injury to passengers, breaking apart, etc.

Engineers should be careful in this, but they must not pass the Surprise Test stop. The company that makes such tests must accept the consequences that result from the same, be they what they may.

Foreign Students in American Colleges.

Many badly informed people look down upon American seats of learning and assert that our colleges do not compare favorably with those of foreign countries, yet students from nearly every country on the globe are seeking education in our colleges. The *Valve World*, published by Crane & Co., Chicago, which has not been noted for favoring our colleges, in a recent issue says:

Statistics compiled by the United States Bureau of Education show that there are 4,856 foreigners enrolled as regular students in the universities and colleges of this country. This year's summer students brought the total up to 5,227. These figures do not include the number of students in preparatory schools. Of the number given 3,983 were under-graduates; 620 were graduates of American colleges taking graduate work, and 624 were graduates of foreign colleges engaged in graduate work here.

These young men are engaged in studying us, in learning our ways and methods, our customs and peculiarities. Most of them will go back to their countries prepared to meet us with our own weapons when we seek foreign markets for our goods.

To what extent are we following their example? How many of our young men are being sent abroad—by our Government where such aid is necessary—to study the methods, the customs, the languages of other lands? How deeply are we engaged in laying the foundations for foreign trade?

It is time we frankly admitted that we cannot successfully enter the domain of foreign commerce by the sheer momentum of our own national success. Our success means nothing to the foreigner. He does not care how we have reached our present industrial and commercial eminence at home.

To be equally successful abroad we must know the customs and the methods of the foreigner; and to know these we must study them on the ground. It would be a wise and practical thing for us to do what Japan and China are doing—send, by Government aid, if needed, young men to study in the schools of those countries while they are sending their young men to study here.

To Tin Brass Taps.

Smooth file to a clean surface the part to be tinned, then sprinkle on surface a little powdered rosin. This acts as a flux to the solder. Next rub the part with a clean copper tool sufficiently hot short of burning the face. The solder will then flow freely and adhere to the tap.

Many have knowledge and still fail to accomplish. Ability to apply knowledge is the necessary factor for success.

Mallet Locomotives for the Denver & Rio Grande Railroad

The Denver & Rio Grande Railroad has lately secured from the American Locomotive Company sixteen Mallet compound locomotives of the 2-8-8-2 type. These big locomotives were designed to meet specific conditions presented in balancing train tonnage over a very heavy grade on the Salt Lake division. With a specified maximum axle load of 50,000 pounds, they are thought to be the most powerful locomotives that could be built. They represent the very latest information as to proportion and employ the best economy factors. One of these Mallet locomotives will take the place of two consolidations now used as helpers, which will then become available for road service. Not only will the number of locomotives per train be reduced, but a greater total tractive effort per train will be obtained, which can be used to meet increased tonnage or adverse conditions.

In accordance with the profile, from Springfield to Thistle, a distance of fifteen miles, the maximum resistance is due to a 1.0 per cent. grade in combination with 7½-degree curves. From Thistle to Tucker, a distance of 17 miles, the maximum resistance is a 2.3 per cent. grade in combination with 8-degree curves. From Tucker to Summit, a distance of 7.9 miles, the maximum resistance is due to a 3.97 per cent. grade in combination with 11-degree curves. This is the crucial part of the division. Hitherto the freight traffic on this division has been handled by consolidation locomotives having a total weight of 221,000 pounds and a tractive effort of 42,000 pounds. These new Mallets have a total weight of 458,000 pounds, 394,000 being on drivers. The theoretical maximum tractive power, working compound, is 93,400 pounds.

With the American Locomotive Company's system of compounding, the normal maximum tractive power can be increased 20 per cent. by changing the engine into working simple. The maximum tractive power of these engines, working simple, is thus 112,000 pounds. The boiler is of the radial stay type with conical connection sheet. At the first course, the barrel measures 85¾ inches in diameter outside, while the outside diameter of the largest course is 100 inches. A combustion chamber, 76 inches long, is also included. High temperature superheat is obtained by the use of a 36 unit, Schmidt type, double loop, top header superheater.

Details of this design follow in general the standards of the builder. Reversing is effected by means of the builder's well known hydro-pneumatic reversing gear. Air operated fire-door and ash pan are also applied. The following are the principal dimensions:

Gauge, 4 ft. 8½ ins.

Weight on drivers, 394,000 lbs.; total running order, 458,000 lbs.

Wheel Base—Rigid, 15 ft. and 15 ft.; total engine, 56 ft. 8 ins.

Tractive power, 93,400 lbs.

Valve Gear—Walschaert.

Cylinders—Diameter and stroke, 26 ins. and 40 x 32 ins.

Driving Wheels—Diameter, outside, 57 ins.

Boiler—Type, Con. Conn.; outside diameter of first ring, 85¾ ins.; course, 100 ins.

Height—Over crown, front, 28 5/16 ins.

Working pressure, 200 lbs.

Firebox—Length, 120⅛ ins.; width, 96¼ ins.

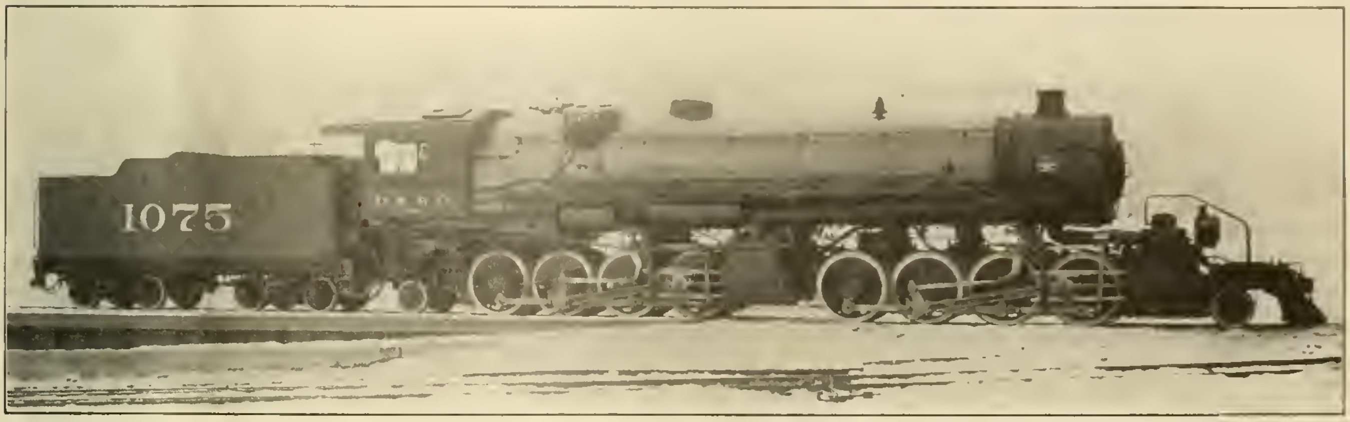
Tubes—No. 255, diameter 2¼ ins.; No. 36, diameter 5½ ins.; length, 24 ft.

Combustion Chamber—Length, 76 ins.

Heating Surface—Tubes, 3,590.9 sq. ft.; flues, 1,239.2 sq. ft.; firebox, 339.6 sq. ft.; total, 5,169.7 sq. ft.; superheating surface, 998.0 sq. ft.; grate surface, 80.3 sq. ft.

Tender—Capacity, 9,000 gals.; fuel, 15 tons.

Length over all, engine and tender, 95 ft. 5⅞ ins.; extreme width, 11 ft. 1½ ins.; extreme height, 15 ft. 5 ins.



MALLET TYPE OF LOCOMOTIVES FOR THE DENVER & RIO GRANDE RAILROAD.

J. F. Enright, Supt. Motive Power & Car Dept. American Locomotive Company, Builders.

Early Track Gauges.

Uniformity of track gauges was not brought about without violent struggles between the advocates of the different widths. The Erie, with its 400 miles of 6-ft. gauge, for a time took the lead, but other interests fought furiously for the standard gauge of 4 ft. 8½ ins.

Very troublesome riots occurred in Erie, Pa., in December, 1853. The owners of the Erie & Northeast Railroad, which extended from Erie to the State line of New York, determined to change the gauge of the road from 6 ft. to conform with the two connecting roads which had a gauge of 4 ft. 10 ins. This would put a stop to the necessity of breaking bulk at Erie, which had been a serious inconvenience to travelers and freight shippers. The legal right to make the proposed change was not questioned, but the people of Erie were opposed to it on the ground that the delay caused at this city was of advantage to them since the delay incurred by travelers led to the spending of money for refreshments and other objects. The Erie people, however, determined that the change should not be made, and very serious riots ensued. It required the power of the State militia to enable the railroad company to effect the changes which were so much desired.

The Oakland, Antioch & Eastern Railway Company of San Francisco, Cal., has ordered from the Westinghouse Electric & Mfg. Company one quadruple equipment of No. 308B-6 Motors and type HL control for use on an electric locomotive. This is a duplicate locomotive ordered by this company several months ago which is now in operation. The locomotive is designed for operation on either 600 or 1200 volts direct current.

The Indicator on Locomotives

There is one point in connection with the use of the indicator on locomotives which we are persuaded is too frequently overlooked. It is too often forgotten that the boiler and the furnace are inseparable parts of a locomotive engine, and that owing to this fact, it frequently happens, and indeed is usually the case, that what would be nearly the ideal indicator diagram for a stationary engine would indicate poor results for a locomotive having the same size cylinders and doing the same amount of work at the same initial pressure and speed.

The performance of a stationary engine in no way affects the economical performance of the boiler which supplies it with steam, and an indicator diagram from such an engine merely shows the performance of the engine only, indicating among other things the pressure at which steam is admitted to the cylinder, regardless of whether that pressure is economically or wastefully maintained in the boiler, the manner of using the steam in the cylinder having no effect whatever upon the economical combustion of fuel in the furnace.

With the locomotive the conditions are essentially different, because the exhaust is depended upon for the blast by which the fuel is burned and the steam kept up. It thus frequently happens that a diagram which would delight the eye of the indicator man, and which would represent to him the very acme of efficiency in that type of engine, would break the back of the locomotive fireman, and cause the engine to die on the road for lack of steam. On the other hand, a diagram which considered by itself, and solely with reference to the economical use of steam in the cylinder, would be considered a very poor one, might prove in practice to be the one giving the best economy by actual weighing of coal consumed. It may be said that for every cylinder of given dimensions, and having steam supplied to it at a given pressure, there is a certain distribution of steam which is the best one for that cylinder when doing the given amount of work. This distribution will be shown by an indicator diagram, which will represent the ideal conditions for that engine and for that work. But if the engine is a locomotive engine the effect of the exhaust upon the fire must be taken into account, and there are many things about the boiler and fire-box, and in the front end, which may have an effect on the character of the exhaust required to give the best results. The kind of coal used, the form of grate-bars, the size and number of flues, the diameter of exhaust nozzles, or the variation of the draft appliances, may materially alter the character of the blast needed to produce the most efficient combustion of fuel; and as this blast is furnished by the exhaust steam, the steam distribution and the indicator diagram representing the best possible performance will be correspondingly modified. This, of course, is no argument against the use of the indicator on locomotives, but should serve as a reminder that the indicator, like everything else, should be used only for the purpose for which it is adapted, and it certainly was never intended for the indication of boilers or fire boxes. The use of the indicator has in the past been confined mainly to engines in which the exhaust has no direct effect on fuel consumption, and the theory of the indicator has been developed by such use of it. Those who propose to use it in locomotive practice must make the proper allowances for the different conditions, and failing to do so they should not blame the indicator, and declare it to be a humbug because they fail to get satisfactory results from it.

This is a matter too frequently ignored; it should always be remembered that the best indicator diagram from a locomotive is in the nature of a compromise between the cylinders and the boiler.

Make Directions Explicit.

An incident of my early life which proved very embarrassing to an engine crew, taught me that directions to do anything to a locomotive should always be made very plain. I was a lad working in the night repair crew, and having little to do much of the time, I was in the habit of lounging about engines getting ready to take out trains. One night when I was lingering about the 33 which was getting ready to take out the mail, the fireman, Jack McNair, arrived. He was in the habit of oiling around and then taking the engine to the station where the driver took hold.

As Jack jumped down with the oil can, he called out to me, "Fill up the fire." I took the order literally and proceeded to shovel in the coal which was very fine till the mass was level with the door. Two hours were lost with that important train before the fire was gotten into steam-making shape.

McNair, who was a morose, narrow-minded Highlander, always held the opinion that I smothered the fire purposely, and said so.

Long afterwards that man gave me a striking impression of the trend of the Calvinistic faith in which most Scotsmen are raised. A fireman in Aberdeen named Rob Dickie was down with pneumonia, a disease very prevalent among enginemen exposed to fierce winters without protection. Dickie was a rough-tongued but kindly young fellow for whom I had kindly feelings, and I went up to McNair, who had just come from Aberdeen, and asked: "Have you heard how Bob Dickie is keeping?" The grim Highlander looked up with a scowl and said, "Tom Dickie's in hell; he died yesterday."

I replied, we are told "Judge not lest ye be judged."

The answer I received was: "You are sure to get there too when you wait long enough." McNair went down on a fishing boat the following year and was drowned. I make no pretense of knowing where he landed.

The Rod v. Coddling.

There is a school for discontented school children in Kansas City, Mo., according to information received at the United States Bureau of Education. The Lathrop Industrial School has been organized for the purpose of educating children over 14 years of age who have reached the fifth grade and find the work of the regular school distasteful.

The institution proceeds on the theory that in many cases the distaste of these children for school is due to the fact that the ordinary studies are not adapted to their particular needs. Such pupils frequently appear "backward" or lazy, when in reality all they need is a different form of educational activity.

All our life we have been acquainted with discontented school children, but the remedy applied and found efficient was different from that adopted in Kansas City, which is carrying to the limit the idea that the human form-divine should never be subjected to pain. The coddling that comes from fear to inflict pain, or to enfore discipline, inspires children with the tendency to strike on school attendance and school work. In the good old days when study was regarded as an imperative duty, the teacher kept on hand a leather strap having six or seven thongs, or a birch rod with pain-inspiring properties. When a scholar displayed laziness or the disposition of discontent that interfered with work, a vigorous application of the strap or birch nearly always effected a permanent cure. We think that judicious application of this is a better means of developing American manhood than the coddling that is becoming so fashionable in Kansas City and elsewhere.

Items of Personal Interest

Mr. Harry Working has been appointed assistant engine house foreman of the Santa Fe, at Claburne, Tex.

Mr. C. Murphy has been appointed erecting shop foreman of the Trinity & Brazos Valley, at Teague, Tex.

Mr. J. B. Rider, general manager of the Pressed Steel Car Company has been elected a director of the company.

Mr. C. L. Waters has been appointed assistant roundhouse foreman of the Central of Georgia, at Macon, Ga.

Mr. E. F. Fay has been appointed assistant master mechanic of the Illinois Central with office at Waterloo, Ia.

Mr. R. W. Anderson has been appointed master mechanic of the Puget Sound lines with office at Miles City, Mont.

Mr. N. J. O'Connor has been appointed master mechanic of the Florence & Cripple Creek, with office at Colorado Springs, Col.

Mr. C. C. Hayman has been appointed road foreman of engines on the middle division of the Santa Fe, with office at Newton, Kan.

Mr. H. O. Inglish has been appointed master mechanic of the Texas City Terminal, at Texas City, Tex., in place of Mr. F. A. Scott.

Mr. W. H. Lee has been appointed locomotive foreman of the Canadian Pacific at Wayburn, Sask., in place of Mr. P. Walz, resigned.

Mr. E. M. Podruck has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha, with office at Elroy, Wis.

Mr. George W. Robb, master mechanic of the Grand Trunk Pacific has transferred his office and staff from Rivers, Man., to Transcona, Man.

Mr. M. McGraw has been appointed master mechanic of the Chicago & Alton, with office at Bloomington, Ill., succeeding Mr. W. E. Ladlay.

Mr. W. E. Maxfield has been appointed master mechanic of the Texas & Pacific, with office at Big Springs, Tex., succeeding Mr. C. E. Boss.

Mr. Lloyd B. Jones has been appointed assistant engineer of motive power of the Pennsylvania lines west of Pittsburgh, with offices at Toledo, Ohio.

Mr. John L. Smith, formerly acting master mechanic of the Pittsburgh, Shawmut & Northern, at St. Marys, Pa., has been appointed master mechanic at that place.

Mr. C. E. Shaw has been appointed tool foreman of the Lake Erie and Western at Lima, Ohio, in place of Mr. T. B. Pinnacle, who has been assigned to other duties.

Mr. E. Fuller has been appointed master mechanic of the Southern Railway, with offices at Knoxville, Tenn., in place of Mr. B. Mude, who has been transferred.

Mr. B. F. Kreis has been appointed road foreman of engines of the Western Pacific, with headquarters at Oroville, Cal., in place of Mr. R. M. Conley, resigned.

Mr. N. S. Airhart has been appointed general foreman of the locomotive department of the Rock Island, at Cedar Rapids, Ia., in place of Mr. C. W. Cuyler, resigned.

Mr. E. W. Williams has been appointed general foreman of the New York Central & Hudson River shops at West Albany, N. Y., in place of Mr. T. H. Leonard.

Mr. W. W. Scott, formerly shop superintendent of the Pere Marquette, at Saginaw, Mich., has been appointed general foreman of the Lackawanna at Buffalo, N. Y.

Mr. G. Hilfrink, formerly general foreman of the Pere Marquette at Saginaw, Mich., has been advanced to the position of shop superintendent in place of Mr. W. W. Scott.

Mr. J. Lemly has been appointed supervisor of locomotive operation, and Mr. H. C. Garaghty has been appointed air brake inspector on the Cincinnati, Hamilton & Dayton.

Mr. R. L. Wheatley, road foreman of equipment of the Rock Island, at Valley Junction, Ia., has been appointed master mechanic of the Southern division, with office at Fort Worth.

Mr. William B. Wood has been promoted from the office of superintendent of the Cleveland and Pittsburg division of the Pennsylvania, to be superintendent of the Eastern division.

Mr. G. E. Perry, formerly master mechanic of the Missouri, Oklahoma & Gulf, has been appointed superintendent of motive power, of the same road, with offices at Muskogee, Okla.

Mr. H. Craswell has been appointed locomotive foreman of the Great Northern shops at Sioux City, Ia., in place of Mr. George Nichols, who has been transferred to New Rockford, N. D.

Mr. Harry Lowman, formerly with the mechanical department of the Southern Railway at Washington, D. C., has entered the sales department of the Chicago Car Heating Company.

Mr. E. Kennedy has been appointed assistant general foreman of the New York Central & Hudson River shops at West Albany, in place of Mr. E. V. Williams, promoted to general foreman.

Mr. J. B. Randall, formerly assistant master mechanic of the Louisville, Henderson & St. Louis, at Cloverport, Ky., has been appointed master mechanic, and his former position has been abolished.

Mr. W. L. Kellogg has resigned as superintendent of motive power of the Pere Marquette, to become superintendent of motive power of the Missouri, Kansas & Texas, with office at St. Louis, Mo., in place of Mr. Wm. O. Herin.

Mr. Wm. T. Gale has been appointed machine shop foreman of the Chicago & Northwestern at Chicago, in place of Mr. J. Buckert, who has been appointed erecting shop foreman at the same place.

Mr. A. Faley has been appointed night roundhouse foreman of the Rock Island at Valley Junction, Ia., and Mr. J. Mansfield has been appointed night roundhouse foreman at Rock Island, Ill., on the same road.

Mr. E. Schultz, formerly roundhouse foreman of the Chicago & Northern, at Milwaukee, Wis., has been appointed master mechanic of the Northern Wisconsin and Lake Shore divisions at Green Bay, Wis.

Mr. J. E. Mitchell has been appointed locomotive foreman of the Grand Trunk Pacific, at Rivers, Man., in place of Mr. M. B. Dube, who has been transferred to Transcona to take charge of the shops there.

Mr. Mindon McGee has been appointed night roundhouse foreman of the Santa Fe, at Las Vegas, N. M., and Mr. E. W. Thomas has been appointed night roundhouse foreman at Riverbank, Cal., on the same road.

Mr. J. F. Hickey has been appointed master mechanic of the Pere Marquette with office at Grand Rapids, Mich. Mr. Hickey was formerly superintendent of motive power of the Mexico North Western at Madera, Mex.

Mr. D. Patterson, master mechanic of the Kansas City, Mexico & Orient, with offices at Wichita, Kan., will perform the duties recently devolving on the office of general superintendent of motive power and car departments.

Mr. John McMullan has been appointed mechanical superintendent of the car department of the Erie at Meadville, Pa., and Mr. Adam Trautman has been appointed shop superintendent at Buffalo, N. Y., on the same road.

President S. F. Bowser, of the S. F. Bowser Company, presided at a banquet given by the company to 40 members of the Pace Makers' Club. The banquet was included in the programme for the annual convention of the club, held in Chicago last month.

Mr. J. E. Osmer has been appointed superintendent of motive power and machinery and master car builder of the Ann Arbor Railroad Company and steamship lines with office at Owosso, Mich., in place of Mr. G. E. Coutant, resigned.

Mr. E. Frank Thomas has been appointed traveling timekeeper of the Baltimore & Ohio system, embracing the Cincinnati, Hamilton & Dayton. He was formerly in the engineering department and will travel over the entire system.

Mr. N. J. Tollerton, formerly mechanical superintendent of the Rock Island Lines, with office at Chicago, Ill., has been appointed general mechanical superintendent of the entire system, Mr. T. Rumney, assistant second vice-president, who had charge of the mechanical department, having resigned. Mr. Tollerton is a typical Western railroad man, of excellent training and wide experience. He entered the service of the St. Paul & Duluth, as a machinist apprentice. In 1890 he was made a foreman for the Union Pacific and later became general foreman for the same company. He was appointed master mechanic of the Utah division of the Oregon Short Line in 1896 and after seven years he was made master mechanic of the Idaho, Utah & Montana divisions of the road. He accepted service with the Chicago, Rock Island & Pacific in July, 1906, as superintendent of motive power. Mr. Tollerton was transferred to Chicago in 1907 as assistant general superintendent of motive power.

Mr. Walter Ladley, formerly master mechanic of the Chicago & Alton at Bloomington, Ill., has been appointed superintendent of motive power of the Reid-Newfoundland Company, with headquarters at St. John, Newfoundland. Mr. Ladley, in addition to having charge of the general report work on the rolling stock of nearly 800 miles of railway, will also superintend the repair work on the company's steamers.

Mr. L. A. Hardin has been appointed general foreman of the Chicago & Northwestern shops at Boone, Ia., in place of Mr. J. W. Anderson, who has been promoted to the position of assistant superintendant at Le Grande, Ore., and Mr. W. G. McMahon, formerly night roundhouse foreman at Boone, Ia., has been promoted to day foreman, and Mr. P. P. Stryker has been appointed night foreman of the roundhouse.

EXECUTIVES OF THE LOCOMOTIVE AND CAR DEPARTMENTS, CANADIAN PACIFIC SHOPS, WINNIPEG, CANADA.

Mr. W. E. Barnes has been appointed master mechanic on the Intercolonial Railway. His jurisdiction extends over all government lines in New Brunswick and Nova Scotia. Mr. H. Sharp has been appointed acting master mechanic with jurisdiction on all government lines in Quebec. Mr. R. Colclough has been appointed assistant to the general superintendent, and Mr. H. B. Fleming has been promoted to the position of assistant district superintendent, vacated by Mr. Colclough, and Mr. C. W. Price has been appointed chief train dispatcher of the St. John and Halifax districts.

Mr. Julius Kruttschnitt has resigned as director of maintenance and operation of the Union Pacific, and has been elected chairman of the board of the Southern Pacific.

Mr. J. H. Tinker, formerly master mechanic of the Chicago & Eastern Illinois at Danville, Ill., has been appointed acting-superintendent of motive power, in place of Mr. S. T. Park.

Mr. Angus McCormick, formerly assistant master mechanic of the New Castle shops of the Baltimore & Ohio, has been appointed master mechanic of the Connellsville, Pa., shops of the same road, and Mr. P. Coniff, who was lately master mechanic at the latter place, and latterly in charge of the erecting department at the Mt. Clare shops, has been appointed master mechanic of the Cumberland division, in place of Mr. J. E. Brady, who will return to the Mt. Clare shops.

Mr. A. P. Prendergast, formerly superintendent of motive power at Cincinnati, has been transferred to Baltimore, reporting to General Manager Mr. C. W. Galloway, of the Baltimore & Ohio line proper, and Mr. N. J. McCarthy, superintendent of the Big Four lines, has become superintendent of motive power. Mr. Prendergast, who is promoted to superintendent of motive power of the Baltimore & Ohio lines has been in the Company's service for 28 years.

Mr. J. B. Ennis is appointed chief mechanical engineer of the American Locomotive Company, with headquarters at New York. He will perform the duties formerly assigned to the vice-president in charge of engineering, except that the chief engineer will report directly to the president on construction and shop engineering matters. Mr. J. B. Ennis is a son of the late W. C. Ennis, master mechanic of the New York, Susquehanna & Western. Mr. W. P. Steele is appointed assistant to the president of the American Locomotive Company, and will perform the duties heretofore assigned to him, and such other duties as may be assigned to him by the president.

Owing to his election as president of the Seaboard Air Line, which necessitated his removal from New York to Norfolk, Va., W. J. Harahan has resigned the presidency of the New York Railroad Club, and Eugene Chamberlin, manager of the Equipment Pool of the New York Central lines, has been elected by the executive committee to succeed him. These changes have resulted in George Wildin, mechanical superintendent of the New Haven, becoming first vice-president, C. W. Huntington, general superintendent of the Jersey Central, second vice-president, and Frederick C. Syze, trainmaster of the Baltimore & Ohio at St. George, Staten Island, third vice-president.

Changes Among Erie Officials.

A variety of changes have recently been made among the officials of the Erie Railroad, mostly in the way of promotion.

Mr. A. J. Stone, till now general superintendent, to which position he rose through successive steps from that of messenger, has been advanced to be general manager of lines east of Buffalo and Salamanca.

Mr. Henry O. Dankle, who entered the service of the Erie Railroad in 1904 and rose rapidly to the position of general superintendent, has been made general manager of the western division with headquarters at Cleveland, O.

Mr. Edgar W. Batchelder is appointed assistant general manager, lines west of Buffalo and Salamanca.

Mr. Robert S. Parsons is appointed assistant general manager, lines east of Buffalo and Salamanca.

Mr. John B. Dickson is appointed superintendent of the New York division and branches, and of the New Jersey & New York Railroad.

Mr. Franklin G. Robbins is appointed superintendent of the Buffalo division and branches, relieving Mr. A. C. Elston.

Mr. Joseph D. Rahaley is appointed trainmaster with jurisdiction over the W.-B. & E. division, and main line between Beaver Lake and Stroudsburg, inclusive.

Mr. John Waldron is appointed chief despatcher, vice Mr. Joseph D. Rahaley, promoted.

Mr. William Leid, road foreman of engines, has been appointed superintendent of locomotive operation of the Erie Railroad with headquarters at Buffalo, N. Y.

Mr. John McMullen has been appointed superintendent of the car department of the Erie Railroad at Meadville in place of Mr. E. A. Westcott, assigned to other duties.

Honored Erie Engineers.

The Erie Railroad has among its engineers "The Order of the Red Spot," which entitles members to have the number plate of their engine painted red. The company has established a roll of honor which entitles some engineers to have their names painted on the cab of their engine. The men who win this distinction are very proud of it.

Following is a list of men whose cabs bear their names, given in the order of their promotion: Samuel W. Evans and Harvey Springstead, of the New York division; Harry W. Smith, Greenwood Lake division; Calvin Vorhis, New Jersey and New York Railroad; William H. Johnson, Northern Railroad of New Jersey; Michael F. Fritz and W. S. Carpenter, of the Delaware division; James J. Salley, of the Rochester division; J. A. Hammond, of the Susquehanna division; W. R. Benedict, of the Buffalo division; T. C. Clark, of the Allegheny division; J. F. Bruner, of the Meadville division; W. R. Slade, of the Cincinnati East; J. M. Dando, of the Cincinnati West; John Wonderly, of the Chicago and Erie; Alexander Larkin, of Cleveland, in the Mahoning division; Philip Nixon, of the N. Y. S. & W. R. R., and William R. Martin, of the Allegheny.

Industrial Co-operation.

The Interboro Railway Company of New York are about to introduce co-operative stores for the benefit of their employees which is likely to prove one of the most beneficent movements ever organized and well worthy of imitation by railway men all over the country. Workmen all over the British Isles have long been noted for carrying on co-operative enterprises and they help very materially in keeping down the cost of living.

The high cost of living which has prevailed among us for the last few years is due in a great measure to the huge profits drawn by middlemen, who exact heavy tolls between the producer and the consumer. Properly operated co-operative stores would purchase directly from the producer and much of the profits secured by mechants would go into the pockets of the shareholders of the co-operative stores.

There are excellent bases for forming co-operative societies in the numerous labor organizations connected with railways. If these would combine in their various locations and establish co-operative stores success would be assured from the start.

Mr. Frank Hedley, general manager of the Interboro Railway Company, talking of the co-operative scheme said:

"We're going to get out a price list and circulate it among the employees and then if they can't get to the store they can send up for a list of the stuff they want and when they get to the barns they'll find it there and they can take it home."

An elective workmen's compensation act, which has the approval of the legislative leaders and the State Insurance Department, has been introduced into the New York legislature by Senator James Foley and Assemblyman James Walker of New York City. The measure is made elective to comply with a decision of the Court of Appeals holding as unconstitutional a compulsory workmen's compensation law signed by Justice Hughes when he was Governor.

Truth is the very basis of character. Without it, no matter how brilliant a man's gifts, there is no firm bottom to hold an anchor.

Sanitation Run Mad.

The writer once listened to an attack on the British ministry by a member of parliament who magnified some trifling defects in army management into outrageous abuses that were likely to bring about disaster. Mr. W. E. Gladstone, who was then prime minister, replied that the tirade of the Hon. Member reminded him of a man who walking in a meadow saw a harmless bush and by an overgrown imagination magnified the shrub into a great upas tree that was spreading poisonous odors over the whole nation.

There is in this country a pestiferous body called the United States Health Service whose functions appear to be the making every small bush into upas trees that are endangering the life of the whole nation. There is no article that people use which this United States Health Bureau is not ready to denounce as a menace to health. Railway companies first received attention by the denouncing of the harmless drinking cup, which resulted in forcing people to purchase individual drinking cups or go thirsty. This piece of petty tyranny was endured so patiently that the "Health" people seem to have lost their heads.

Now the small fry State officials have found out that they could inflict embarrassing restrictions upon the public under pretense of making sanitary regulations and everything becomes a source of contamination under their petty mysophobic imaginations, so that timid souls see infection in every article of daily use. The useful roll towel has been replaced by obnoxious paper towels, finger bowls are proscribed, dusting of rooms is put under ban, picture frames are condemned as harborers of disease, and now the Pullman mattress is likely to be replaced by some inelastic article incapable of harboring microbes. Carpets, draperies and everything else that contributes to comfort in the household must be dispensed with if the sanitary cranks have their way. Among the doomed things are all household pets, brooms, carpet shaking and other innocuous practices.

The health officials are in the position of the English puritans after the Restoration. They prohibited all sorts of amusement, not because they were vicious or sinful, but because they gave the people pleasure. Was there ever a people like Americans to meekly submit to idiotic rules and senseless laws?

Telegraph poles have been found very convenient as means for hanging negroes in some parts of the country where trees are scarce. We have noticed two cases within a month in which public spirited citizens of Texas used telegraph poles to end the lives of suspected persons. There is a little too much of what in Auld Lang Syne was called Jeddart Justice in Scotland—hanging the culprit then trying him.

Crosshead Clearance.

In the operation of adjusting a crosshead it should be observed whether the key in the back end is in front or behind the crank pin. When in front, as is generally the case, the main rod is lengthened, as the brass wears and the key is driven down, and when the key is behind the crank pin, of course, the rod is shortened. Allowance should be made for this according to the total amount of clearance available. It is also advisable to consider the amount of space occupied by the piston rod. It is usual to allow at least one thirty-second of an inch more clearance at the back end than on the front end. This has the effect of equalizing the amount or volume of exhaust. In the engine house it is frequently necessary to disconnect a main rod and put it up again. When it is impossible to move an engine to either of the dead centers, a line should be made with a pencil at either ends of the crosshead before the main rod is disconnected, and care should be taken to note that the crosshead exactly corresponds with the lines after the operation has been completed. The tendency of the crosshead to move one way or the other by repeated repairs on the main rod is very great.

An Unpopular Life Saver.

The humanitarian people who are striving to promote safety in various lines of industry, are following lines long ago advocated by Mr. Plimsoll, an English member of Parliament. Mr. Plimsoll's particular hobby was the advocacy of laws and rules calculated to prevent loss of life at sea, and among all classes of people who go down to the sea in ships or any kind of craft.

Before Mr. Plimsoll began his philanthropic labors there was no load line established for ships and some rascally ship owners were in the habit of deliberately overloading vessels with the hope of collecting high insurance money. Plimsoll succeeded in having a law passed which established a load line which brought upon his devoted head a storm of abuse from the shipping interests which had previously profited by the murder of sea-going people. That did not deter Phinsoll from seeing that the laws against overloading were obeyed.

The Bay of Biscay was a most hazardous region for overloaded ships. The year before Plimsoll's load-line law went into force 26 vessels sank in the Bay of Biscay, carrying 176 persons to a watery grave. The first year that the law was in operation two vessels were lost in the Bay of Biscay and 26 people were drowned. In spite of that Mr. Plimsoll was for years the most viciously abused man in the British Isles.

Resurrected Invention Against Sea-Sickness.

It is curious how many inventions are repeated after proving worthless. People crossing from England to France very often suffer from seasickness crossing the English Channel. Many years ago Henry Bessemer, the famous steel maker, invented a steamer which he thought would prevent seasickness. The cabin was hung in a sort of enlarged binnacle and kept level no matter how much the boat might roll about, just as a ship's compass keeps level. That did not prevent sickness for it did not prevent the vessel from dropping downwards. The drop is what causes the stomach to turn over.

One of the latest items of news in the New York papers reads:

"A bed whose mechanical arrangement keeps it equipoised regardless of the ship's position was brought to port last night on the White Star liner Majestic, from Southampton. It was designed to prevent seasickness, and those interested in its promotion contend that it is impossible for one to become seasick if one sticks to the bed day and night when the weather is rough."

Post Office Exactions.

The Post Office Department have long been notorious for exacting onerous service from patrons sending printed matter through the mails, and they are starting out on the operating of the Parcels Post on the assumption that patrons are bound to perform services which are not required by law.

It might be supposed that a publisher was at liberty to deliver mail matter in bulk to the nearest post office leaving to the government employees the work of arranging the packages for their proper destination. That is not permitted. The "Department" has worked up rulings that require publishers to arrange their mail by districts and towns, reducing the labor of post office employees to a minimum.

People using the Parcels Post cannot pay for the service by using ordinary postage stamps. They must use Parcels Post stamps to perform the work of bookkeeping for the department. The convenience of the public receives no consideration when the interests of the Post Office Department are in question.

A Cleaner for Brass.

In some recent laboratory experiments the following solution was found to cleanse brass very quickly without harm to the hands or the metal. An ounce of alum was put into a pint of boiling water and the solution rubbed on the brass with a cloth. Stains as well as tarnish were quickly removed. The solution is inexpensive and easily prepared.

RAILROAD NOTES.

The Chicago & Western Indiana is said to have ordered 3,000 tons of steel rails.

The Rutland has ordered 7 locomotives from the American Locomotive Company.

The Erie has ordered 10 Pacific locomotives from the American Locomotive Company.

The Santa Fe, it is said, will build a new roundhouse and repair shops at Gallup, N. M.

The Duluth, South Shore & Atlantic is reported to have ordered 5,000 tons of steel rails.

The Lehigh Valley has ordered 10 Mikado locomotives from the Baldwin Locomotive Works.

The Duluth & Iron Range has ordered two Mikado locomotives from the Lima Locomotive Corporation.

The Vandalia, it is said, has ordered 10,000 tons of steel rails from the United Steel Corporation.

The Carolina & Northwestern has ordered 4 Consolidation locomotives from the Baldwin Locomotive Works.

Butler Brothers have ordered 4 6-wheeled switching locomotives from the Baldwin Locomotive Works.

The St. Louis & San Francisco, it is reported, will erect a new roundhouse in the present season at Thayer, Mo.

The Delaware, Lackawanna & Western has ordered 1,000 tons of girder rails from the Pennsylvania Steel Company.

The American Refrigerator Transit has ordered 1,000 refrigerator cars from the American Car & Foundry Company.

The Chicago, Indianapolis & Louisville has ordered 4,000 tons of rails from the United States Steel Corporation.

The St. Louis, Iron Mountain & Southern purpose erecting a new roundhouse at Argenta, Ark., at a cost of $40,000.

The Delaware & Hudson Company has ordered 15 Consolidation locomotives from the American Locomotive Company.

The New York, Chicago & St. Louis has ordered 5,000 tons of Bessemer steel rails from the Lackawanna Steel Company.

The Cincinnati, New Orleans & Texas Pacific has ordered 10 Consolidation locomotives from the Baldwin Locomotive Works.

The Minneapolis, St. Paul & Sault Ste Marie is said to have ordered 10,000 tons of steel rails from the Pennsylvania Steel Company.

The Chicago, Rock Island & Pacific are arranging to purchase about $125,000 worth of machine tools in the early part of the present year.

The Elgin, Joliet & Eastern is said to have closed contracts for the larger portion of the machinery required for the new shops at Joliet, Ill.

The Wabash is asking for bids on an extensive list of machine shop tools, looking towards a thorough re-equipment of some of their principal shops.

The Duluth, Missabe & Northern has ordered 22,000 tons of steel from the American Bridge Company for its proposed ore dock at Duluth, Minn.

The Harriman lines have ordered 50 locomotives from the American Locomotive Company, and 208 locomotives from the Baldwin Locomotive Works.

The New York Central lines have ordered 1,000 box cars from the American Car & Foundry Company for the Cleveland, Cincinnati, Chicago & St. Louis.

The Pennsylvania lines West have ordered 6,600 tons of bridge steel to be used in a bridge at Sheridan, Pa., which will be known as the Ohio connecting bridge.

The Boston & Maine has ordered 600 tons of bridge material for several new bridges. The largest portion of the order was placed with the McClintic Construction Company.

The Pennsylvania has ordered 40 superheater Consolidation freight locomotives with cylinders 26 ins. by 28 ins.; driving wheels, 62 ins. in diameter, and a total weight of 254,000 lbs. for the American Locomotive Company.

The Cuba Railroad has ordered 4 10-wheel locomotives from the American Locomotive Company. These engines will be equipped with 18 by 24

in. cylinders, driving wheels 52 ins. in diameter, and will weigh 127,000 lbs.

The Missouri, Oklahoma & Gulf will award the contract for the new machine shop, engine house and car shop at Muskogee, Okla, at an early date. The shop equipment will be driven by electricity throughout. The cost will be over $100,000.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered five superheater Pacific passenger locomotives with 25 x 28-in. cylinders, driving wheels 75 ins. in diameter, and a total weight of 258,000 lbs. in working order, from the American Locomotive Co.

The Pennsylvania Railroad Company has arranged to construct an expensive cut-off on the New York and Philadelphia division which will shorten the distance between these cities but will cut New Brunswick, Metuchen and Mento Park off the main line.

The Grand Trunk Pacific is calling for bids for machine tools, motors, furnaces and general equipment for its car shops at Transcona. Specifications may be had from the office of Mr. W. J. Press, mechanical engineer, Ottawa, Ont. Bids must be submitted by February 13.

Tests of a Jacobs-Shupert Boiler.

A handsome volume of 171 pages has just been published by the Jacobs-Shupert Firebox Company, embodying a report of tests of a locomotive boiler of the company's special design in comparison with a radial-stay boiler. The work is by Prof. W. F. M. Goss, of the University of Illinois, under whose superintendence the test was conducted. The details of the test which occurred recently are given in full with numerous fine illustrations, and in the summary Prof. Goss states that the steaming qualities of the Jacobs-Shupert boiler are, in general, the same as those of a radial-stay boiler, but that it may be forced without danger of injury to higher power, and in the matter of circulation it possesses some advantage when compared with other types of locomotive boilers; that its superior strength under low water conditions permits it to endure overheating without failure for long periods of time, where the normal radial-stay boiler quickly fails; and that where the overheating is so severe that it cannot be resisted, the result will be a blow-out and not a disastrous explosion.

Today.

No man ever sank under the burden of today. It is when tomorrow's burden is added that it seems more than one can bear. Live, then, today, and tomorrow will always be bearable.

Train and Steamer in Collision.

For a railway train to come into collision with a liner steamboat, both train and steamer keeping on their natural element is an extraordinary event, yet such a collision was a feature of the floods that devasted the Ohio Valley in January last. The St. Louis *Republic* describing the accident says:

A railroad train and a river steamboat collided head-on at Cumberland City tonight. The wreck, probably the most remarkable on record, was primarily caused by the flood and secondarily by the confusion of signals between the two carriers.

The railroad locomotive plowed into the starboard side of the steamer, and travel by both rail and water became suspended at that point.

During the flood that has inundated the Ohio Valley and its environs for the last week the Cumberland River has been on its biggest boom in many years.

To-night the small steamer Lochie S., wheezing across the lowlands and far from the usual river channel, meandered across the Louisville & Nashville Railroad tracks. The rails are four feet under water, and the Lochie S.'s draft gave her plenty of sea room.

The railroad, in its safeguarding against traffic hold-ups by floods, has special engines with high fireboxes that can plow through high water. And so it came to pass that the Lochie S. was just in time to meet a freight train.

The boat crew sighted the train. Then began a series of short, sharp blasts from the steamer's whistle. Interpreted under the river code, they meant "Full speed astern."

But the freight engineer didn't know, and in the dark he didn't see the steamer on the right of way. There was a grinding crash and the engine cow-catcher was buried in the boat's side.

Small boats were summoned to the rescue and towed the steamer to a landing. The train proceeded on its way. No one was hurt. But the Supreme Court probably has gained some interesting questions to pass on along the lines of "When is a river not a river?"

Not speaking of who will be entitled to damages.

Understood Comfort.

The traveler met an old colored man with a balky mule.

"What's the matter with him, uncle?" asked the traveler.

"Full of pure cussedness, sah. He'll stay right in dat same position foh two or three houahs, sah."

"That so? Why don't you build a fire under him?"

"What? A fire under dat mule! Lands, mister, if Ah built a fire under dat mule he'd stay all day en wahm hisself."

Narrow Escapes and Others.

One time, says one of our correspondents, I was running a passenger train over a line that was remarkably free from train accidents, but was also noted for the absence of special orders issued to engineers and other trainmen. A heavy rainstorm had been raging all afternoon and I was watching closely for washouts. Cypress Creek is a very rapid stream and the bridge across it is at the foot of a steep grade. To climb this grade we generally crossed the bridge at very high speed. I had commenced to make the speed-acquiring run when something seemed to whisper, "how does the flood affect the bridge?" I felt a little ashamed at what I considered cowardice, but I applied the brakes. That enabled me to stop the engine a few yards from the black rushing water where the bridge had been.

I never again was ashamed to risk delay by taking the side of safety.

* * * *

Zeal to make a good record is what develops the chance-taker and leads the way to disaster. Bruce was a train engineer and heeded not danger when his train full of passengers encountered a cloudburst, for he pushed ahead amidst storm and stress until he ran into a washout in which he left his life along with that of nine others.

* * * *

Sullivan, Happy Joe, was noted for reckless running but he had had wonderfully good luck and was popular with the train dispatcher as an engineer likely to make up time if that were possible. One day he was passing through a heavy rain pour, but pushed on until he struck a creek where a bridge ought to have been had it not been carried away. Joe was drowned and seven other human beings were killed or drowned.

* * * *

Last month while pulling an important express train, Roberts went into a drenching rain storm and was worried between the desire to make time and the thought of taking his train in safely. He remembered certain places where heavy rains sometimes sent streams of water over the track and approached such places cautiously. One bank, where repairs had been carried out during the summer, was approached with dread but slowly enough to stop before the engine plunged into a deep washout. His train reached the terminus late, but all safe and sound.

* * * *

The engineer who brings his train in safely is among the great majority of his calling, but no particular attention is given to his performance. He has merely done his duty. It is the unfortunate who has met disaster that the reporters of the press associations delight to tell their readers about. However heroic an engineer may be and however bravely he may have struggled to lessen disaster, there is no comfort to the man when his wife has been made a widow.

Jack of All Trades.

There is a certain species of mechanic who is ever ready to leave his own job and hasten to fix up anything that has gone wrong about the machinery, the lighting or the heating apparatus. That man needs watching. His readiness to undertake work that does not belong to him is a species of soldiering that ought to be discouraged.

It is that species of man complained of by a housekeeper who says: After you've been two weeks in the house with one of these terrible handy men that ask their wives to be sure and wipe between the tines of the forks, and that know just how much raising bread ought to have, and how to hang out a wash so each piece will get the best sun, it's a real joy to get back to the ordinary kind of man. Yes, 'tis so!" Mrs. Gregg finished with much emphasis. "I want a man who should have sense about the things he's meant to have sense about, but when it comes to keeping house, I like him real helpless, the way the Lord planned to have him!"

No Knowing Where He Will Stop.

"Well," said a Glasgow mother to the grannie, "if this lad of mine has any particular leaning, I can't discover it. I've taken your advice, and the experiment proved an utter failure." "What did you do?" "I went on the lines you advised. I gave him a toy steam engine, printing press, horse and cart, box of paints, set of carpenter's tools and several things and left him in the room with them. After an hour I went back to see which he had chosen." "Well?" "Well, he'd smashed them all up; simply made scrap of them, and now I'm at a loss to know what trade or profession to train him up to. Come and look at the wreck." They went together to the playroom. In the middle was a heap of debris, on the top of which sat little Willie performing on the only unbroken article left—a pewter whistle. "Well," said the grannie, "it's plain enough. He will begin as a railway porter, rise to be guard, and there's no knowing where he'll stop; probably he'll become a director in time."

Suitable Name.

"What's that you call your mule?"

"I call him 'Corporation,'" answered the old colored man.

"How did you come to give him such a name?"

"F'um studyin' de animal an' readin' de papahs. Dat mule gets mo' blame an' abuse dan anyt'ing else in de township, an' goes ahead havin' his own way jes de same."

Books, Bulletins, Catalogues, Etc.

Railroad Construction.

"Railroad Construction" is the title of an excellent book of 321 pages which has just been published by the McGraw-Hill Book Company, New York, and is the joint work of Charles Lee Crandall and Fred Asa Barnes, members of the American Railway Engineering Association, and who have brought a profusion of learning and a wealth of experience to their work. The bulk of the work has been used in one shape or other for the use of the students in the College of Civil Engineering at Cornell University. The work is divided into ten chapters and embrace complete details in regard to earthwork, rock excavation, tunneling, masonry, foundations, culvert and bridge masonry, trestles and bridges, track material and railroads, and estimates and records. The work is fully illustrated. The paper, press-work and binding have all the high class qualities that distinguish the work of the enterprising publishers. The price of the book is three dollars.

M. C. B. and A. R. M. M. Association Conventions of 1913.

A circular has just been issued by Mr. Joseph W. Taylor, joint secretary of the Master Car Builders' Association and American Railway Master Mechanics' Association furnishing particulars in regard to the conventions to be held at Atlantic City, N. J., this year. The master mechanics, convention will assemble on June 11 and continue during the two following days. The car builders will meet on June 16, and continue sessions on June 17 and 18. The meetings as formerly, will be held in the Greek Temple. The Marlborough-Blenheim Hotel has been selected as the headquarters for both conventions. Copies of the circular may be had from the secretary, 390 Old Colony Building, Chicago, Ill.

Illustrated Lectures on the Baltimore and Ohio.

Mr. C. W. Egan, general claim agent, will deliver an address on railroad safety, illustrated by stereopticon views which show the contributory causes of numerous railroad accidents both to passengers and employees. This lecture has been delivered by the Baltimore & Ohio general claim agent at each division point on the system, as well as at similar meetings conducted by other railroads. The photographs show actual conditions and railroad employees at work in busy terminals, on trains and in shops, also numerous safety devices which have been adopted for the protection of the traveling public and the men to whose care their lives are entrusted.

Instructions on the Pennsylvania.

No less than 85,000 copies of a booklet are being distributed among the employees of the Pennsylvania lines, and from which we quote the following suggestions: It is a recognized fact that the majority of injuries occur not as the result of serious accidents which attract public attention, but from the comparatively trivial occurrences of the daily employment—carelessness in getting on and off moving trains, or in the use of tools, from reckless exposure to unnecessary risks, or from sheer thoughtlessness.

Graphite.

The January issue of *Graphite*, published by the Joseph Dixon Crucible Company, Jersey City, N. J., has an interesting article on the subject of "Protection Paint Coatings" which should be read by those interested in the subject. It is well known that the cost of maintenance of any iron or steel structure will enormously incerase if the protective paint coating deteriorates rapidly and has to be renewed within a comparatively short time. The use of Dixon's Silica-Graphite Paint more nearly fulfills the requirements of a final protective coating under all kinds of conditions than any other protective paint, and the records received by the company surpass anything we have had the opportunity of examining.

Standard Heat and Ventilating Company.

The Standard Heat & Ventilating Company, 141 Cedar street, New York, of which Mr. J. F. Deems is president, have completed arrangements whereby they have acquired the rights of the Ward Equipment Company and the Safety Heating & Lighting Company, relating to car heating and ventilating, and will manufacture and sell the devices in these special lines heretofore furnished by both the above companies. The Safety Car Heating & Lighting Company will also act as agents for the new company. The aim of the new company is to standardize and simplify car heating and ventilating apparatus, and thereby increase efficiency and reduce costs. The manufacturing facilities of the new company are of the best, and their fine products may be relied upon as of the best.

Good Value Free

The December issue of *Reactives* contains some very interesting information regarding welding, and the illustrations accompanying the descriptive articles make the book doubly attractive. This book may be had without charge. Write for the "December *Reactions*" to Goldschmidt Thermit Co., 90 West street, New York.

Purchasing Coal on Heat Unit Basis.

One of the coming just changes in power matters is the purchase of coal by the heat unit instead of by weight. It would largely profit railway companies to purchase fuel according to quality instead of the blind methods now in vogue. We understand that the municipal authorities of Chicago have introduced the practice of purchasing coal on the basis of heat units.

In the case of the Chicago deliveries, if the coal test shows 13,000 British thermal units, moisture 10 per cent. and ash 8 per cent., the price is to be $2.30 per ton; but if the coal varies in heat units the price is to vary accordingly.

On a 5,000 ton contract an analysis of the coal is made once a week. The sample is taken by the regular method and analyzed and reported to the consumer and the contractor.

Is This the Meanest Man?

Instances of remarkable and ingenious selfishness are, unfortunately, not hard to find. A writer in the New York *Sun* gives one which would be difficult to match. Two strangers met at one of the small tables in a dining-car. They found a common bond in the effort to secure something to eat, and by the time the coffee came they were on friendly terms.

"I wonder if you will do me a favor," said the first one, as he paid his bill. The other man seemed receptive, and the first one continued:

"Have you a lower berth for tonight?" The man across the table nodded.

"Well, I'm traveling with my mother, who is rather well along in life, and I'm anxious to make her comfortable. Would you be willing to give her your berth?"

"I should be delighted," responded the stranger.

They went back to the sleeper, where the accommodating man was presented to the other's mother, a white-haired old lady with a charming face.

The Good Samaritan had exchanged his lower berth for the upper, belonging to the old lady, and was radiating with a sense of charitable kindness. It led him to remark affably to the other man:

"But where are you going to sleep?"

"Oh, that's all right," was the answer. "That's my lower over there."

Not All Fools.

A lady, fresh from helping the striking London dockers, discussed on the *Lusitania* the new status of woman. "You perceive the new and high status of a woman," she said, "in the respect that men now show this respect. I remember a story——" She smiled. "A man and his wife," she said, "were wrangling. The wife, completely out of patience, at last exclaimed—'Are all men fools?' 'No, my love,' the man answered, 'some are bachelors.'"

Too Happy for Glasgow.

An amusing story is told by Will J. Johnson, of the Pyle National Headlight, of experience in Glasgow, Scotland, last summer. On a dreary Sunday morning he went strolling around George Square, where he met a dour looking policeman who eyed him suspiciously.

"Ye had better take care what ye'er daen," said the cop.

"What am I doing that's wrong?" exclaimed Johnson, "why I'm not even whistling or singing."

"Na I canna say ye are," returned the minion of the law, "but ye'er looking as happy as if it was a Monday mornin' instead o' the Serious Sawboth day."

Voices of the Engines.

At the last meeting of the Traveling Engineers' Association in the course of his inaugural address President Hayes said: "To teach all engineers that there is a language which the locomotive speaks and which every engineer worthy of the name readily understand; for every piece of apparatus about the locomotive has its voice of contentment, or wail of protest. Hence, the ability to understand and appreciate that language fully cuts a large figure in locomotive performance."

That expresses noble ideas which were given words by Kipling in McAndrews' "Song of Steam," in which he says:

"Lord send a man like Robbie Burns,
To sing the song o' steam;
To match wi' Scotia's noblest speech
Yon orchestra sublime;
Whaurto—uplifted like the Just—
The tail rod marks the time;
The crank throws give the double bass,
The feed pump sobs an' heaves.
An' now the main eccentrics
Start their quarrel on the sheaves;
Her time, her own appointed time,
The rocking link heads bide,
Till—hear that note?—the rod's return
Whangs glimmerin' thro' the guides.
They're a' awa'! True beat, full power,
The clangin' chorus goes,
Clear to the tunnel where they sit,
My purrin' dynamos.
Interdependence, absolute,
Foreseen, ordained, divined.
To work, ye'll note, at any tilt,
And every rate o' speed.
Frae skylight lift to furnace bars,
Backed, bolted, braced an' stayed,
An' singing like the Mornin' Star,
For joy that they are made,
While out o' touch o' vanity,
The sweatin' thrust-block says:
"Not unto us the praise, O man,
Not unto us the praise!"
Now a' together, hear them lift
Their lesson—theirs and mine:
Law, Order, Duty and Restraint,
Obedience, Discipline!"

Permanent Manufacturers' Exhibit

Railway Supplies and Equipment

Notes of the Exhibits and Club Rooms

The Standard Train Resistance Computer and the Equated Tonnage Method of Making Up Freight Trains.

The Standard Train Resistance Computer is an adding machine to be used in the yard offices of trunk lines for totaling up the tonnage of freight trains. Unlike the ordinary adding machine it at the same time makes allowance for light and heavy cars, adding them into a train according to the drawbar load they are going to put on an engine rather than according to their actual weight. This is called equated tonnage. As every practical railroad man knows, two trains of equal tonnage, the one made up of empty cars and the other of loaded cars will not put the same load on an engine, the train of light cars pulling much the heavier of the two. This is easily accounted for, however, since the train of empty cars would have perhaps twice the number of cars of the train of loads, which would mean twice the number of pairs of wheels to turn, etc., hence the difference. Looking at this in another way it may be said that the lower the average car weight of a train the higher the train resistance per ton of the train, or in other words the greater the number of pounds of drawbar pull required per ton of the train.

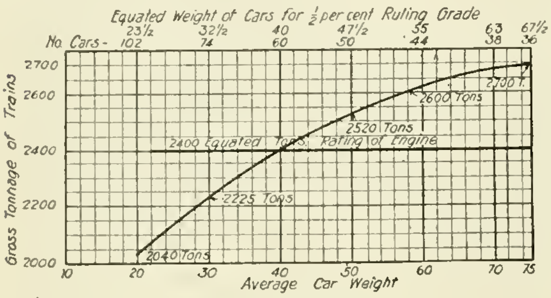


FIG 1.—CURVE SHOWING NECESSARY VARIATION IN GROSS TONNAGE OF TRAINS TO PLACE CAPACITY LOAD OF 35,200 LBS. DRAWBAR PULL ON ENGINE WHEN RUNNING AT TEN MILES PER HOUR ON RULING GRADE.

With this fact in view a series of tests were conducted some time ago on the Illinois Central Railroad by the Illinois State Railway Experiment Station to determine the relation existing between the resistance or the number of pounds drawbar pull required per ton of a train, and the average car weight of a train. The complete results of this series of tests showed that there is an increase of 60 per cent. in resistance due to a decrease of from 75 to 15 tons in the average gross car weight of trains. This is, of course, the vital point at issue. In the results given above all effects due to grades, curves, etc., have been eliminated and for this reason the values as given are termed internal train resistance values. The effect of grades, curves, etc., must be treated separately for each division when engines are being rated, the maximum grade being the deciding factor which limits the load an engine can haul over any given division.

This method, like a number of others that have been tried out at different times, would be unpractical and burdensome from a clerical standpoint if it were dependent on the yard clerk to work out the equated tonnage of each train mentally, and it was to make this method a practical issue that Mr. J. M. Daly, general superintendent of transportation of the Illinois Central, invented the Standard train resistance computer, a machine, an illustration of which is shown in Fig. 2, that has been in practical use for several years. It embodies the above principle of equated tonnage and at the same time serves as an adding machine for the yard clerk. The machine is 14 by 14 ins. in size and weighs 28 pounds. It has a circular face plate marked with tons and fractions of tons. Within, and concentric with this plate, is a narrow perforated ring, the perforations coming opposite the divisions on the plate. At the center are two registers, one showing the number of cars and the other the adjusted tonnage. To work the machine the point of a stylus is inserted in a hole in the movable ring opposite a figure and the ring rotated to the right until the stylus strikes a stop under the plate. The stylus is withdrawn and the operation repeated as many times as there are cars to add, the machine adding the equivalent tonnage each time and showing on the register in the center the total equivalent tonnage and also the number of cars that have been added. For example, if the way bill calls for a 60-ton gross weight car, the stylus is put in the hole opposite this number and the ring is rotated to the stop. The register adds only 55 tons instead of 60 tons; for a car weighing 30 tons it adds 32½ tons. When the register shows 2,400 tons, if that be the rating of the engine, the train is complete, whether its actual tonnage be 2,040 tons or 2,700 tons. The drawbar pull in either case will be the same. As this work can be done by the yard clerk in a very few minutes, the saving in time in dispatching a train is obvious.

It may be added that roads that have been using this machine and method for the past five or six years are realizing a saving of from 5 to 10 per cent. in their train mileage items. On the Champaign-Chicago division of the Illinois Central R. R. exact records of one machine's performance was kept for a period of one year. It showed a saving of 10 per cent. in train mileage representing $30,000.

FIG. 2. THE STANDARD TRAIN RESISTANCE COMPUTER.

Ogle Construction Company.

The Ogle Construction Company, Chicago, Ill., are meeting with much success in their new designs of Balanced Bucket Type Coaling Stations of various capacities which have been adapted to locations when the requirements were for one or more tracks. Their designs have all been tested and in every instance fully meet the claims of the manufacturers. Our illustration of an all-steel coaling station

shows a construction that is absolutely fireproof. The entire superstructure is steel except the machinery house which

ALL STEEL COALING STATION.

is of concrete. The design is such that either spout is used. This prevents spontaneous combustion and makes this type of chute especially derirable on railroads using lignite or other low grade fuels.

There is every reason to expect a steel coal chute to last as long as a bridge or any other steel structure. At locations where lumber is expensive their low cost makes them especially attractive and a strong competitor of all other classes of construction. The construction is heavy, rigid and compact and cannot be injured or pulled out of line in case of an obstruction entering through the hopper. Being salf contained, they will not bind or work hard in case of settlement of walls or shrinkage of timber.

This company also make a specialty of coal chute machinery, hoist, buckets, loaders and spouts, as well as water stations, pumping stations, water cranes, pipe lines and bridge turning machinery.

Railway and Locomotive Engineering Headquarters, Karpen Building, Chicago.

As stated recently in our columns Railway and Locomotive Engineering has been officially adopted as the organ of the Permanent Manufacturers' Exhibit of Railway Supplies and Equipment, and it consequently became necessary for us to establish suitable headquarters for the accommodation of our staff and constantly increasing number of friends and visitors. The accompanying illustration shows a view of our Booth, which is one of the most commodious and elegant in the building. Our idea is to have our headquarters in the Exhibit suited for the special accommodation of railway men, and to that end facilities for correspondence and telephone service are at hand, and it is gratifying to know that in this regard the conveniences of headquarters are being much appreciated. Mr. Allen G. Wood, consulting engineer, of our editorial staff, is frequently in attendance, and his services to railway supply men as well as to intending purchasers of railway equipment are being constantly called upon.

It should be remembered that in the unavoidable absence of some of our staff, the officials in the Exhibit will readily be able to place visitors in touch with our representatives.

Car Foremen's Association.

At the January meeting of the Car Foremen's Association of Chicago, held in Karpen building the evening of January 13, Mr. I. S. Downing, Master Car Builder of the L. S. & M. S. Ry., at Cleveland, Ohio, presented a very interesting paper on shops—"General Arrangements and Facilities." In the course of his interesting remarks Mr. Downing pointed out the growing need for better equipment of car shops, and presented a detailed plan with a complete list of the necessary tools. In regard to light repairs the paper contained many valuable suggestions, among others the writer claimed that light, medium and running repair shop should be located conveniently to switching yard, and where room and yard layout will permit, should be located centrally in yard, or where cars can be handled to repair tracks with the least movement. Consideration should be given to further expansion. There are many light repair tracks where the switching yard has been built around the shop, making it impossible to increase the capacity of the light repair branch and in these yards it has been necessary to place additional repair yards at points which are not convenient, which also means additional supervision and extra switching to place the cars. The light repair branches are of the utmost importance, as cars must be repaired promptly to keep freight moving. They also keep light and medium repairs out of the general repair shop. A great deal more thought should be given to this class of shop than has been given in the past. These shops bear the same relation to the general repair shop that the roundhouse does to the back shop.

The entire evening was devoted to a discussion of this paper and many interesting facts brought out, which will appear in the February Proceedings of the Car Foremen's Association.

RAILWAY AND LOCOMOTIVE ENGINEERING HEADQUARTERS, BOOTH NO. 96. KARPEN BUILDING, CHICAGO.

Aaron Kline.

Mr. Aaron Kline is acquiring a very enviable reputation as secretary of the Car Foremen's Association of Chicago,

AARON KLINE, SECRETARY, CAR FOREMEN'S ASSOCIATION.

which is holding its regular monthly meeting in the Karpen building. Mr. Kline was elected secretary in 1900, when the membership numbered about 200. In 1904 the membership had increased to 900. During an absence of two years from Chicago his presence at the meetings was much missed and on his return to Chicago in 1906, he was again elected secretary and has continued in that office to the present time. He is the right man in the right place.

President F. C. Schultz, of the Car Foremen's Association, on Car Loading.

At a recent meeting of the Car Foremen's Association in discussing the able paper presented by Mr. F. Lucore on the subject of "Delays to Freight Cars," Mr. Schultz gave his views at considerable length from which we extract the following remarks which should be of interest to all interested in car loading:

"I want to explain that in the operation of the Chicago Car Interchange Bureau, I asked that my attention be called to each case where empty cars were delivered to connecting line for loading, that is, not fit for the load intended. On receipt of this information, I took up with the proper transportation officer of the railroad interested, calling their attention to this matter, and most of the replies received read as follows:

"'This matter has been taken up with the Car Department, and we hope that there will be no further trouble of this nature in the future.'

"They did not view the matter from the proper light, and it became my duty to explain to the operating officers that the question of correcting this was entirely in their own hands, and in place of criticizing the car inspector for permitting the car to be used for this lading, that they should line up their Yard Department, to furnish the car inspectors with a list showing the kind of cars that were wanted, and the class of lading for which they were intended, so that they could pick out the car that was fit for the lading for which it was intended. It is my experience that in order to get enough cars for loading, and save expense in handling and delays, that no cars should be delivered to connecting lines for loading, unless they have been "O. K.'d" by the Car Department, and it is my experience that it is good practice in large yards where cars are picked up for loading, to have a man assigned to this work, and the best man that is available is none too good for this service, as he saves a great deal of expense in handling, switching charges, and inconvenience and disappointment to both consignee and consignor."

Curtain Supply Company.

A curtain is never a curtain in the true sense of the word unless it is a usable curtain. Probably nothing is more annoying to a traveling public than a badly designed, poorly made, and worse, a car curtain that does not do that for which it was intended. The perfect operation of the Curtain Supply Company's curtains and fixtures is demonstrated in the models on exhibition. What is also worth remembering is that they operate with the same efficiency on thousands of railroad cars as they do in the models exhibited.

Nickel-Chrome Chilled Car Wheel Co.

Titanium in a car wheel mixture acts as a "flux" and goes off with the heat. It is a "scavanger" and will clean up a poor mixture but adds no strength or durability in wear. The "F. C. S." wheel manufactured by this company professes to have a different material in the chilled tread, another different material in the plate and another in the hub, but as this would involve the use of three different ladles to pour each car wheel, it is safe to say that it is not carried out in practice. Another claim for it is that there is more chill on the flange, but as there is no strength in a chilled surface this only weakens the flange besides resulting in "chipping."

Railway Club Headquarters.

We have already called attention to the growing facilities of the Permanent Manufacturers' Exhibit of Railway Supplies and Equipment, and we are pleased to be able to reproduce a photograph of the club's headquarters which has now become a popular feature of the establishment. In this commodious club room meals are served at all hours of the day. The membership of the club is rapidly increasing, and as is customary in rooms of this kind members have the privilege of bringing quests with them. This is being largely taken advantage of and the club room is growing in much popular favor. Visitors, especially railway men from a distance, will find the club room ready of access and of special advantage in meeting with men interested in the various departments of railways.

RAILWAY CLUB HEADQUARTERS, KARPEN BUILDING, CHICAGO.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVI. 114 Liberty Street, New York, March, 1913. No. 3

At the Grand Central Terminal

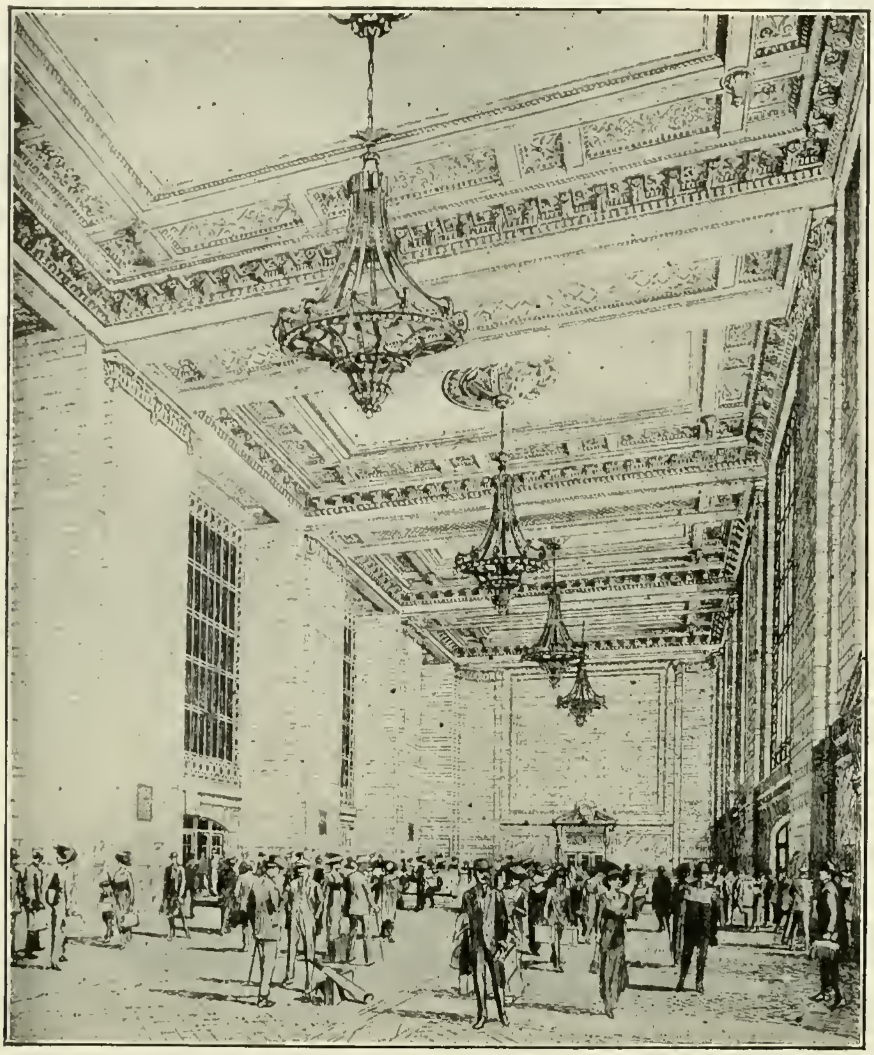
In our imperial city with its palaces and towers, some in gray granite, and some in burnished beauty, white as monumental alabaster, the new—wonderful as it may be, attracts but limited attention. The magnificent new Library, in the majestic splendor of Greek architecture, and something in architecture that seems to defy competition. Not only in its colossal vastness, but in its perfect and harmonious utility it is really something new in railroading. Fifteen regiments of armed infantry could come to order in its waiting room, without touching each other. Over gineering miracle could have arisen into the mighty perfection to which it has attained without interfering with the vast traffic that has been going on without interruption. Surely this is a triumph of engineering skill that has no parallel in the world's history. This will assuredly

BIRD'S EYE VIEW OF THE GRAND CENTRAL TERMINAL, NEW YORK.

worthy of the age of Pericles, is already old and familiar. The Singer Tower and the Woolworth Building are being threatened. Their giraffe-like loftiness lacks the dignity of proportion, and they all dwindle in the presence of the completed Grand Central Station. This is one thousand trains a day start from the unseen recesses of this caravansary and go on their winged way with a degree of regularity and smoothness that rivals the stars in their courses. As one gazes at the symmetrical and far-extending pile the thought naturally arises how this engineering miracle could have arisen into ... be the greatest gateway of traffic for many years to come.

While the entire work has not been completely finished, as it is contemplated to extend the offices and other buildings for which the ground is already secured, the formal opening for general traffic oc-

curred last month, and the public had an opportunity of comprehending the nature



MAIN WAITING ROOM FOR OUTGOING PASSENGERS.

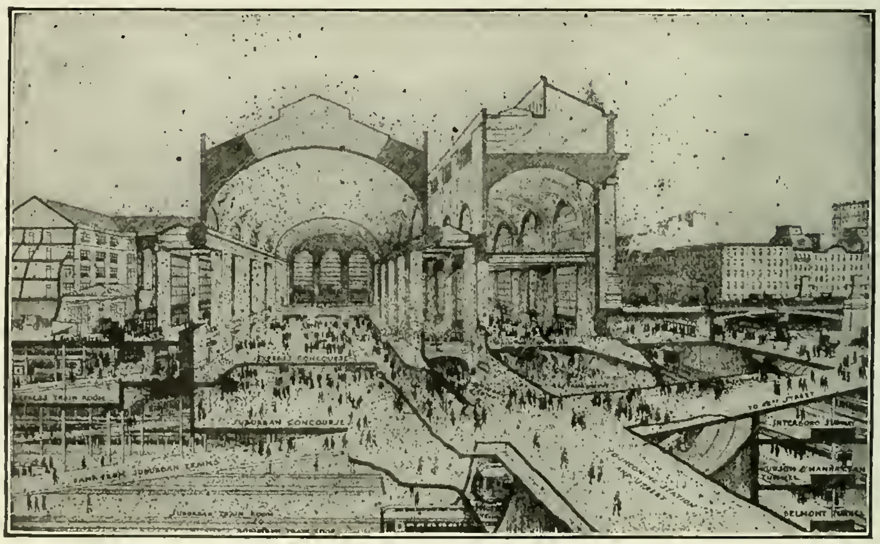
and extent of the work accomplished.

In the history of railroad building there is nothing to compare with the work at Grand Central. It is a comparatively easy matter to dig a hole, lay tracks and put up a building, but to rebuild a station under traffic, change the entire plant so that not a vestige of the old remained, keep 800 trains running and handle from 75,000 to 100,000 passengers a day, was a proposition alive with engineering and operating problems. To do this, the first thing required was more room; large purchases of land were made abutting Lexington, Park and Madison avenues, increasing the area from twenty-three acres in the old terminal to seventy-nine acres in the new, including both levels of tracks. As each new track or group of tracks was finished a corresponding number of old ones was abandoned, and traffic went on without interruption. How well this problem of building a terminal and operating trains at the same time has been worked out is illustrated by the travel over Labor Day last year. During the eight days from August 30 to September 6, 1912, the number of people in and out of the terminal totaled 944,000. There were 4,826 trains handled during this same period with an average delay of but twenty-one seconds per train, which is as nearly perfect a record as the most skillful operation can effect.

It is doubtful indeed if the work could have been accomplished but by the use of electricity instead of steam as motive power. The tracks were depressed below the street level, Park avenue and the cross streets from Forty-fifth street to Fifty-sixth street built in, thus reclaiming about twenty city blocks and throwing the entire area open for building purposes. Contrast in your mind's eye a steam-and smoke-filled railroad yard with blocks of handsome commercial buildings, office structures, hotels, apartment houses and club houses, all of harmonious architectural design, and you will have some conception of what a transformation is taking place. It is probably the largest, and promises to be the most successful, combination of the esthetic and practical in city building yet planned in the world.

Returning to the terminal area proper, which is dominated by the main terminal building. In designing this building, the exterior finish of which is granite and Indiana limestone, the architects had in mind an expression of the old terminal idea, which is a gateway to a city, hence the central part of the facade is in the form of a triumphal arch of monumental proportions surmounted by a statuary group representing Progress, Mental and Physical force. The style has something of the Doric motif, modified by the French Renaissance, with only enough ornamentation to relieve the severity of the classic lines. As one of the architects expressed it: "It is not an Art Museum nor a Hall of Fame, but a place of dignified simplicity, easy of access, and comfortable."

In the mere matter of exact dimensions it may be briefly stated that the total area of the new terminal is 79 acres, the old terminal which it supersedes being 23 acres. The tracks in the terminal proper measure 33.6 miles. The length of the station on the street level is 672.5 feet,



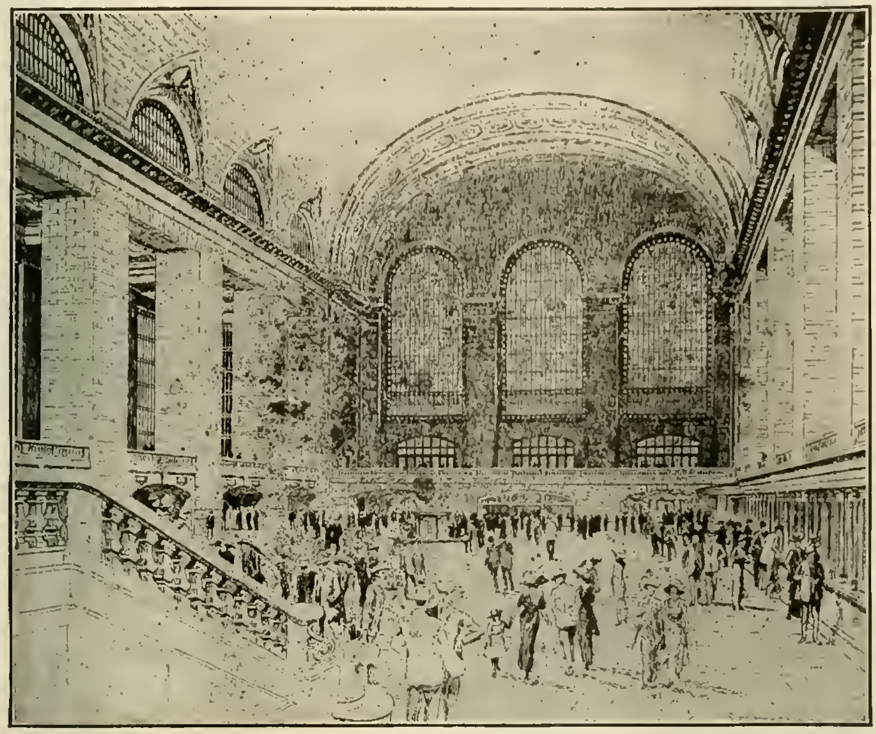
CROSS SECTION OF MAIN BUILDING.

with a width of 310 feet, and 150 feet high. Below the street level the length is 745 feet, 455 feet wide, and 45 feet deep,

making a distance of 195 feet from the lower tracks to the roof. In all 118,000 tons of steel was used in the construction. The interlocking switch and signal tower has 760 levers, 400 of which are used on the suburban or lower level and 360 on the express or upper level.

The most noteworthy and impressive feature of the new Grand Central terminal is the mighty room that runs across the main structure and whose center line exactly coincides with the center line of Forty-third street. That room, the main concourse, is one of the notable rooms of the land. When you come to measure the thing with any degree of exactitude you will find that in comparison there are few notable rooms in the land, the dome rooms of the library and the Capitol at Washington coming most quickly to mind among these. The concourse of the new station ranks with these famous and wonderful American apartments. It is not alone its size, although you could put the sizable New York city hall within it, cupola, side wings and all. It is certainly not in its decorations, for here as elsewhere in the big station side walls and ceilings are dignifiedly notable for their absence of meaningless bas reliefs or gaudy tiring colors. It is rather in the general effect of the room—that intangible but very potent thing that painters are sometimes apt to denote as atmosphere—that it achieves its tremendous success, for you could hardly create a single walled-in and roofed apartment 300 feet long, 120 feet wide and 125 feet in height from its marble floor to the apex of its curved ceiling, a room lined with the impassively beautiful Botticino marble, without creating a room that would rather stagger the human at first sight of it.

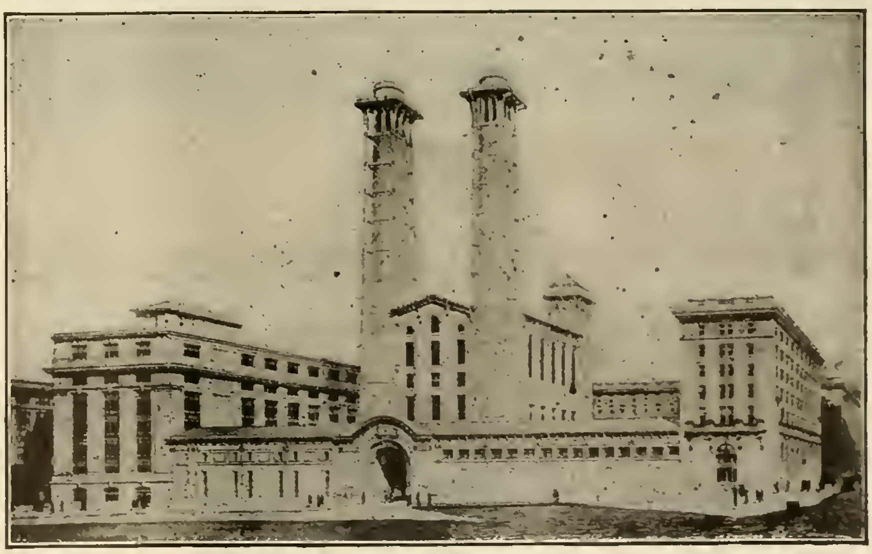
Here, then, is the heart of the station. From the south side of this room are the many ways that lead to and from Forty-second street—the main frontage of the terminal—and between them the ticket offices, waiting room and other general facilities for the traveler. At either end are low galleries, the one given to a carriage entrance upon the overhead way of the new Vanderbilt avenue at the west of the station, the other designed for a future resting place of the famous "Dewitt Clinton train," the engine and group of tiny cars that made the first trip upon the old Mohawk and Hudson railroad away back in 1831 and which in so doing gave birth to the mighty New York Central system. At the north side of the concourse are a dozen entrances, clearly marked and designated, according to the experiment and skill of traffic experts. Your mind goes to what you may call the real railroad features of the terminal.



OUTBOUND CONCOURSE.

Before leaving the heart of the station however, it is particularly interesting to glance a moment at the expansive ceiling. The dominant note of the color scheme is a turquoise blue such as one sees in the sky of Greece and of southern Italy. The contour of the ceiling produces a gradation of tone that gives an effect of illimitable space. As one passes down the incline to the suburban concourse and catches a glimpse of the ceiling beyond the immense stone columns, which shut out a complete view of the room, there is revealed a picture of wondrous beauty and so startlingly natural that one for the moment imagines himself in some old building of Pompeii having no ceiling save the blue sky itself.

The view presented is a section of the heavens as seen during the months from October to March, or from Aquarius to Cancer. Sweeping across the ceiling from east to west are two broad bands of gold, representing the Ecliptic and the Equator. The figures and signs are in their relation to one another and to the Ecliptic and Equator as nearly as possible astronomically correct and extend on a segment of a circle across the entire ceiling. The signs of the Zodiac in progression are Aquarius, Pisces, Aries, Taurus, Gemini and Cancer. Besides the signs of the Zodiac, there are depicted certain constellations familiar to every one who lets his vision sweep beyond the tall buildings of our city. Among them are Orion, Pegasus, Musca and Triangulae. The signs and constellations are drawn on the blue field in gold outline and modeled



POWER AND HEATING PLANT.

delicately with a stipple of tiny stars.

The stars, of which there are some 2,500, are indicated in their proper scale of magnitude, and the great stars which mark the signs and constellations are illuminated, giving them a remarkable perspective, just as one sees them twinkle on a clear winter night.

To give an idea of the immense scale of the figures it is only necessary to say that from Rigel, the star marking the toe of Orion, or the Hunter, to Propus, marking the tip of his club, there is an expanse of forty feet. The other constellations are on a similarly large scale.

Proceeding to what may properly be called the electric brain of this system is at Fiftieth street, the electric switch and signal tower. This tower is in itself worth going a long way to see. From it is governed the movement of hundreds of trains over an intricate web of sixty-seven tracks, day in and day out, year in and year out.

It is the twentieth century idea in the electrical control of trains. It is the largest thing of its kind in the world, and to the perfection of its operation is committed the safety of millions of passengers a year.

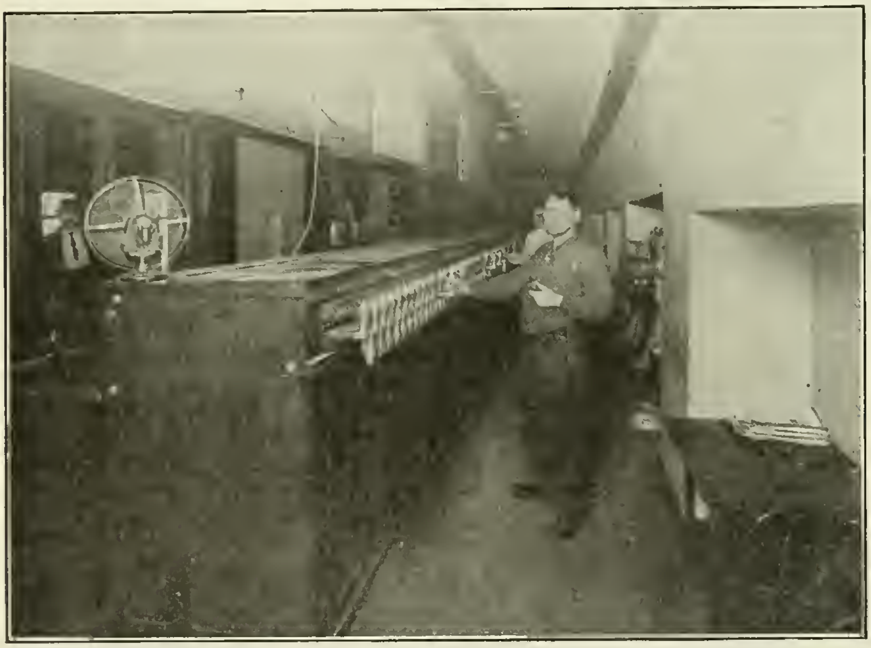
In the old days, when the tracks were open to the sky, it took an army of men to throw the switches by hand in the terminal yards. Later, with the coming of the control of switches from the towers, it took a smaller army to throw the long levers back and forth. That was called the manual system. Then came the automatic system, that was worked by compressed air, then the combination of air and electricity. Now it is electricity alone that does the work. Three or four men pacing to and fro in front of a long row of little handles now set the interlocking switches and the signals.

Should the tower director call a wrong number or should one of the men misunderstand him and pull the wrong lever the electric indicators would show the error at once. Not only that, but that particular section of the interlocking system of switches and signals on the tracks outside would show it to the eyes of the engineer.

Even if the engineer did not see it the train would be "tripped" automatically and brought to a stop until the error was rectified. This signal tower below the surface of the street is the last word in electrical control of trains. It was put in full operation only a short time ago.

A ramble through the miles of corridors that run through the extensive office building reveals a commercial labyrinth already occupied by numbers of the leading supply houses of America, and opens up visions of the colossal future of the great commercial center of which the creation of the new terminal is the leading cause.

We cannot close this brief sketch of so great a work without expressing our gratitude to Mr. Eugene Chamberlin, the worthy and genial manager Equipment Clearing House, who is a complete encyclopedia in himself and whose knowledge of the details of the great building has been of much service to us in presenting some of the facts and figures in relation to the new gateway of the railroad with which he has been so long and prominently identified.



ELECTRIC SWITCH AND SIGNAL TOWER.

Practical Speed of Trains.

Professor Hadley says, "the speed of railroad trains is restricted within three theoretical limits: First, a physical limit of 80 miles an hour, beyond which it is found impossible for a train to hold the track; second, an operating limit of 60 miles an hour which practical experience has found trains cannot run without much damage to life; third, a commercial limit of 30 miles per hour at which, all things considered, it is found most economical to run a train." These are the views of a learned College Professor who speaks with authority that is not based on knowledge.

Arbitration.

A strong feeling of satisfaction is expressed in railroad circles that the threatened strike of the firemen and enginemen on the Eastern railroads has been averted. Whatever varying opinions may exist as to the demands of the workmen and the attitude of the managers, it must be admitted that the law as embodied in the Erdman Act was primarily established to meet such emergencies. If the law is defective it should be amended. If it is useless it should be abolished. We have frequently alluded to the British Board of Trade as an admirable example of the successful handling of workingmen's grievances and the establishment of a similar board in this country could not fail to bring good results. Many British laws are relics of the dark ages, but there are flashes of light here and there that our legislators might kindle their torches at and lead us on to better things.

Growth of the Mechanic.

One of the curiosities connected with the manufacture of machine tools and such mechanical appliances as clocks, sewing machines, etc., in the United States is that the entire business has been developed since the country became an independent nation. The mechanic arts and the development of the manipulative skill have grown by degrees as the needs of the people demanded, and the people who developed into skilled mechanics came largely from rural occupations. The ingenious blacksmith who could repair any kind of mechanism reared the boy who took a lead in making chronometers; the handy carpenter who could repair wind mills became a working millwright and trained the youths who became machinists and makers of machine tools.

Testing Tools.

Micrometers, squares and gauges are precision tools, and those used should be the property of the firm and be periodically tested for accuracy. Those which are the property of an employee should not be allowed to be used unless subjected to such inspection and test.

General Correspondence

Old Timers.

Editor:

Enclosed are two photographs of engines which I though might interest you and your readers. One of them is

LOCOMOTIVE, "COUNTESS OF DUFFERIN."

the "Countess of Dufferin," the first engine to enter Winnipeg, Man., on the Canadian Pacific about 1884, and was built by the Baldwin Locomotive Works. The engine is now on permanent exhibition at Winnipeg and you will please note the flower boxes on the front and sides of the locomotive. These are filled with flowers in the summer. The building behind the locomotive is the Hotel Royal Alexandria.

The other locomotive is Pennsylvania Lines No. 1030 and was taken at Toledo, O. I am informed that this is one of the old "Class I" type of "consols," new "Class H-1." These were first built in 1875 and were shown at the Centennial in 1876. This particular engine was built at the Fort Wayne shops in 1878. These engines were the standard motive power until they were replaced by the "Class R" type of engines. The cylinders were 20 ins. by 24 ins., and drivers 50 ins. They had diamond stacks and cross-head pumps with slanting roof sheet to the firebox and were known as "Altoona" boilers. There are very few of these on the Pennsylvania Lines now and they have disappeared entirely from the Pennsylvania.

CHAS. E. FISHER.

Ann Arbor, Mich.

PENNSYLVANIA LOCOMOTIVE, NO. 1030.

A Sixty-Year-Old Locomotive.

Editor:

Enclosed is a picture of one of a class of engines built at Malone, N. Y., by Mr. Abram Klohs, in the late 50's, who was master mechanic of the Ogdensburg and Lake Champlain Road for many years. There were nine of these engines; this engine and two others had 50-in. driving wheels—the others larger wheels. This engine, "The Champlain," and two others, had cylinders 15 ins. by 22 ins.—the other engines had different sizes. They all had straight boilers, no dome. Sand boxes were put on in '66; no hand-rails; they were fitted with perforated dry pipe high up in the boiler, had a large fire box. They had some novel features: The bell hung between the escape pipes; they had solid end-fluted rods, made light but with large surface; back end main rods; spade-handle four distance block; one bolt and key just as used today; they had inside oil cups, frost pipes connected to branch pipes close up to boiler check, and carried under jacket into cab and discharged into pipe down through deck head, headlight the same as being used today. Crossheads, wrought-iron inside, with case-hardened thimble for wrist pin, two cast-iron blocks running in guides with one bolt passing through both blocks and thimble, and taking pins of plunger at end. You will notice stack, also finished iron bands around boiler, throttle in front end. I ran one of these engines in 1866; they were very smooth and good steamers, and economical on fuel. There were many things about them that would look odd at this time, but everything was good and they did good work. Mr. Abram Klohs, master mechanic, is seen standing near the engine; Engineer Guyette in cab—both long since passed away.

CHAS. C. ROWELL.

Onawa, Iowa.

LOCOMOTIVE "CHAMPLAIN." OGDENSBURG & LAKE CHAMPLAIN RAILROAD.

The Automatic Train Stop.

Editor:

Recently the Interstate Commerce Commission recommended as follows: "Railroads ought to unitedly experiment with the automatic train stop until a device of practicability for general use shall be available." This recommendation was made after two very serious wrecks had occurred on a large New England railway, the trouble being caused by the engineers disregarding the signals and taking cross-overs at high speed. These wrecks have so stirred public opinion that the road in question has made a very liberal offer of a prize to whoever shall invent some device that will stop the train automatically after it has run by a signal.

When the matter is considered seriously, it does not seem to be a very difficult proposition for it is plain that what is needed is some apparatus that will shut off the steam from the cylinders and set the brakes entirely independent of the engineer. Such a device may be operated by pure mechanical means, by air or by electricity. The air is already available and some locomotives have electric generators on them.

The problem of setting the brakes on a moving train from an outside source is not an experiment as is shown by the use on electric elevated trains of an arm which rises up between the sleepers when the signal is set for danger and if the train passes over it it will come in contact with a lever that opens a valve on the brake pipe and thus sets the brakes. It is somewhat more difficult to arrange a device that will cut off the steam from the cylinders at the same time. This

must not be so complicated as to easily get out of order and no part of it must project too far from the side of the locomotive to be objectionable. It must also be capable of being set back to the original position without any trouble and it should be so simple of design that the man of limited experience may readily understand its operation. Since the modern locomotive has developed into a very complicated machine, any device that is added should combine with reliability of action simplicity of construction and also it should contain as few parts as possible, having them easily accessible for inspection. This device should also be located outside of the cab so that would be no temptation for the engineer to cut it out of service while running along on the road.

Since on a steam road the space between the rails is often filled with snow or some other substances which might set such a device in operation when there was no necessity for it, it would seem as if the best place to locate the operating lever would be on the side of the machine projecting from the side of the steam chest. To describe such a device in detail: I think that there should be valves placed in the steam pipes leading to the steam chests and holes could be cored in the saddle castings for the stems and bonnets to project outside. These valves should be made of ample proportions so as not to impede the flow of the steam and they should be balanced. To their stems there should be connected small pistons working in cylinders having on the sides opposite the valves coiled springs similar to those in the air-brake cylinders, which would press against the pistons and tend to keep the valves closed. To the valve side of the cylinders there should be a small pipe about ¼ or ⅜ in. in diameter leading to the air supply so that when the air was turned on the pressure would be amply sufficient to open the valves against the pressure of the spring on the opposite side of the piston. There should also be an exhaust pipe of double the area of the supply pipe which should run from each cylinder and be combined into one slightly larger in area, this one to lead to a valve on the side of the steam chest which is provided with a lever that, being thrown, would release the air from the cylinders and allow the valves to close. The exhaust should be of greater area than the supply so that with it open, there would not be enough air flowing into the cylinders to create any pressure.

The releasing valve should be made double in design and having two connections, one for the exhaust pipe from the valve cylinders, and the other to the pipe controlling the air brakes so that one lever would at the same time as it closed the valves cause the brakes to be set.

To manipulate this lever it is necessary that an arm should be operated so that by raising it a certain distance it will be in a position to move the lever when the train passes. This could be placed on a short post similar to the dwarf signal standards and it would need to be of metal and of heavy construction to withstand the shock of a swiftly moving train, and it could be either pulled up by a chain or by a rod and could either be connected to the chain that works the semaphore or be separate as might be thought best. It is doubtful if the use of electricty would make the operation of this device any more certain, although it might be less expensive to install the working parts, a saving which would be nullified on any locomotive that did not already have a source of electric current.

Thus, with a locomotive equipped with this device, should it run by a signal, or if the engineer was unable to stop it through some accident and the train was running uncontrolled, as the operator in the tower throws the signal to danger, the contact arm also rises on the short post opening the releasing valve on the side of the steam chest and the air is exhausted from the valve cylinders allowing the springs to seat the valves shutting off the steam while at the same time the air has been released from the train line allowing the brakes to set just as if the train had broken apart and the locomotive is brought to a stop without the help of the engineer. To start again it will be only necessary to close the releasing valve and the air pressure will immediately build up and open the valves and allow the brakes to be released.

I have no doubt but that a perfected machine will be much better than the one that I have outlined and there does not seem to be any weighty reason why such a one cannot be designed that will answer all of the requirements.

H. W. Kimball.

East Dedham, Mass.

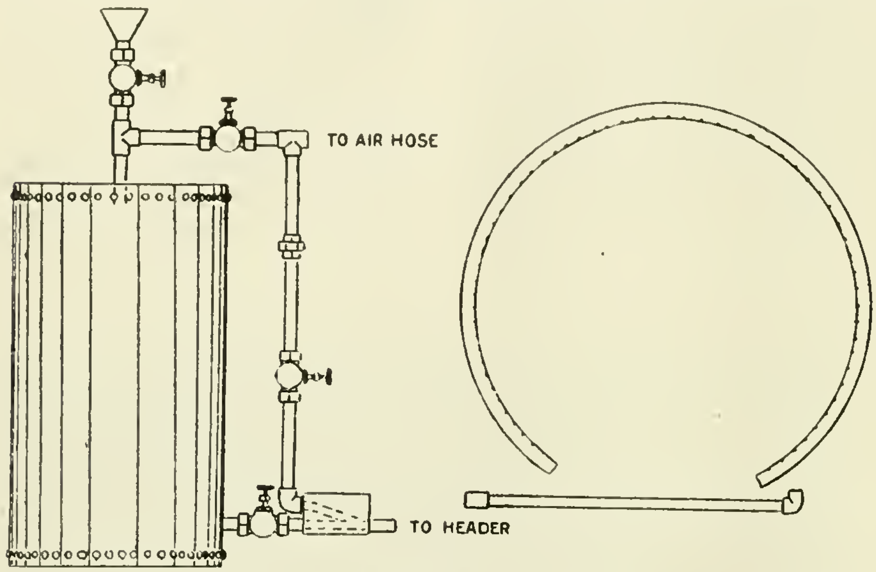


FIG. A. WHEEL FLANGE HEATER.

Tire Heater, Forge, and Wheel Pit Jack.

Editor:

Enclosed find four sketches of good devices for use in locomotive repair work in roundhouses. Fig. A shows a home-made wheel flange heater for warming the tires of locomotive wheels and which may be readily constructed in any repair shop at a limited expense.

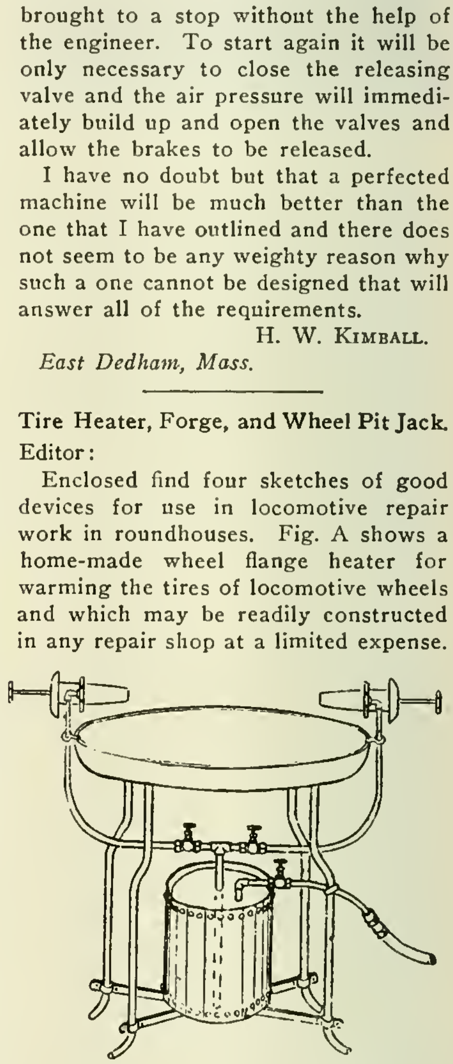


FIG. B. GASOLINE FORGE.

Fig. B shows a typical gasolene forge for forging copper pipes, flanges, unions on copper pipes, and other similar work in the constant requirements of general roundhouse work.

Fig. C shows a common wheel pit fitted with air lifting cylinders for changing the driving wheels, when necessary, of the running engines, as also when changing the wheels on front or tender trucks.

Figs. D and E show the jack head adapted to receive the axles of the

wheels from which the wheels may be readily transferred preparatory to removal; the jack head, together with the pin, E, may be withdrawn from the jack cylinder when the apparatus is not in use. J. G. Koppel.

Montreal, Canada.

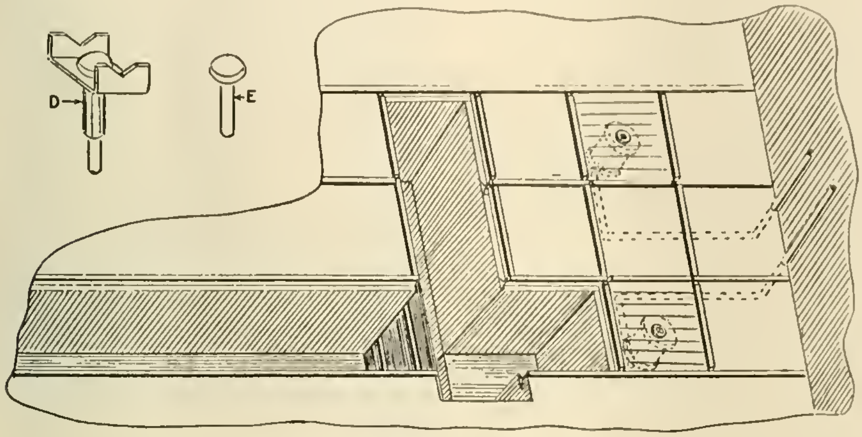


FIG. C. WHEEL PIT APPARATUS.

The Misuse of Sand.

Editor:

Mr. Smoot's letter on sand pipes in the February issue of Railway and Locomotive Engineering is very good as far as it goes but, in my opinion, he should have gone further. The railway companies go to the expense of equipping their locomotives with air sanders, so that sand may be used judiciously, and with an assured degree of certainty, at the required time. There is also considerable expense in loading, hauling and drying the sand preparatory to using. After all this care there is an unpardonable amount of carelessness manifested when the employees who fill the sand boxes allow coal, clinkers, cotton waste, and other substances to get mixed with the sand in the boxes, with the result that the pipes are soon stopped up. The plug is then taken out and a long wire is used in an effort to clear the pipe, which is often clogged up again after running a short distance, and then the engineer and fireman become desperate, and the pounding of the pipes with hammers begins and frequently continues until the thin sand pipes are split. The result is that the train is stalled. Then it is a case of doubling or delay, and when the terminal is eventually reached, there may be some extended controversy on the causes of the delay, and finally the handy man removes the plugs again and gets his wire into operation, and after a slip-shod examination reports the sanders to be in working order. As soon as one proceeds on another journey the miserable muddle is repeated. The thermometer may be dancing about zero, and the north west wind singing a melancholy tune, but no kind of wind gets through the sand pipes until an exhaustive series of operations have been performed.

The writer has had his troubles with the conditions referred to just a few miles further north from the locality where Mr. Smoot seems to suffer from the same causes on the Ohio side.

S. W. Walker,
A. C. L. R. R. Co.

Sumter, S. C.

Waste in Valve and Cylinder Lubrication.

Editor:

It will be remembered by the older railroad men, that before the use of hard grease in the lubrication of crank pins, that the connecting rods, and everything along the sides of locomotives were covered with oil, and the oil and mud would be scraped from underneath the running boards, at least half an inch thick, every thirty days. This waste ceased when grease came into use. The waste is not now so great, but there is still a great deal of oil wasted. For example, in the inside of valve chests and cylinders there are about sixty square feet of non-bearing surface, as against about forty feet of bearing surface, and therefore there is nearly as much oil adheres to the non-bearing surface that is entirely wasted, as it never reaches any bearing surface. This loss is increased by a certain amount of the lubricant given off by the steam before entering the cylinder and being applied to the bearing surface, so that if the various causes are considered, and the amounts of losses added together, it will be found that there is a total waste of at least seventy-five per cent. of valve and cylinder oils, that produce no effective returns.

D. Morehouse.

Delphos, Ohio.

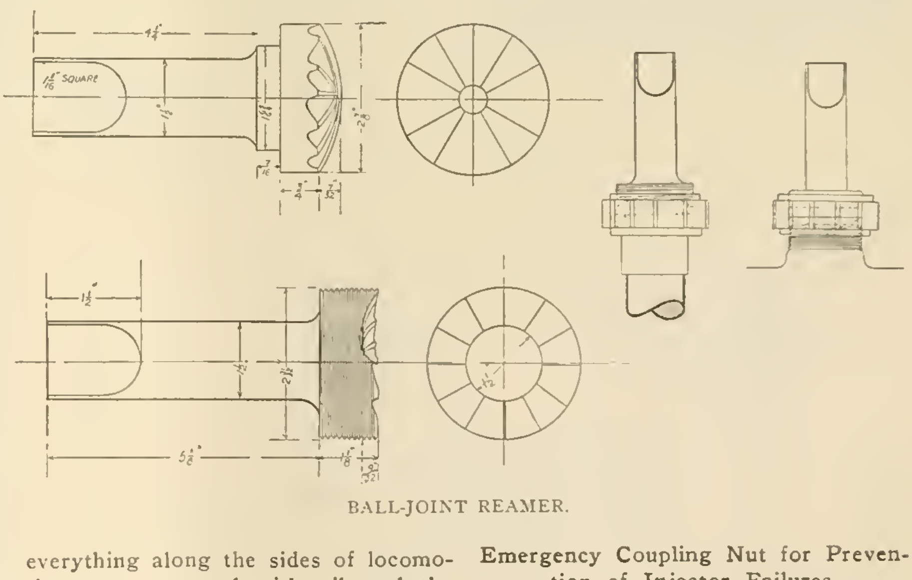
Ball-Joint Reamer.

Editor:

Attached print shows injector boiler check, ball-joint reamers, which are used by hand when male or female ball joints are in bad condition. These reamers do very accurate work and can be taken to the engine and work done, in place of taking the work to lathe. This print shows one of the tools at work on male injector connection and the other one on female steam pipe connection. These tools are held central to their work by the original connection nuts, which nuts also feed the tool to its work, while a few turns of the tool with wrench completes the job.

Chas. Markel,
Shop Foreman.

C. & N. W. Ry., Clinton, Iowa.



BALL-JOINT REAMER.

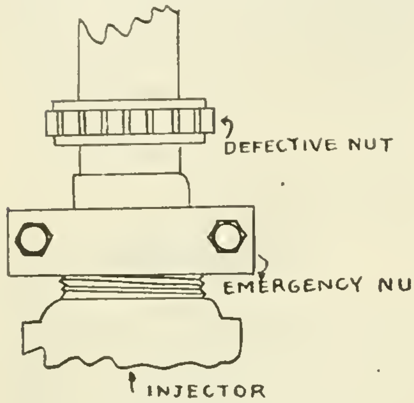
Emergency Coupling Nut for Prevention of Injector Failures.

Editor:

A good percentage of locomotive failures or delays at the roundhouse will be found due to stripped injector coupling nuts; the steam pipe coupling nuts to the injector being in the majority of cases the ones at fault. The above condition of these nuts is invariably discovered at a time when the engine has but little time

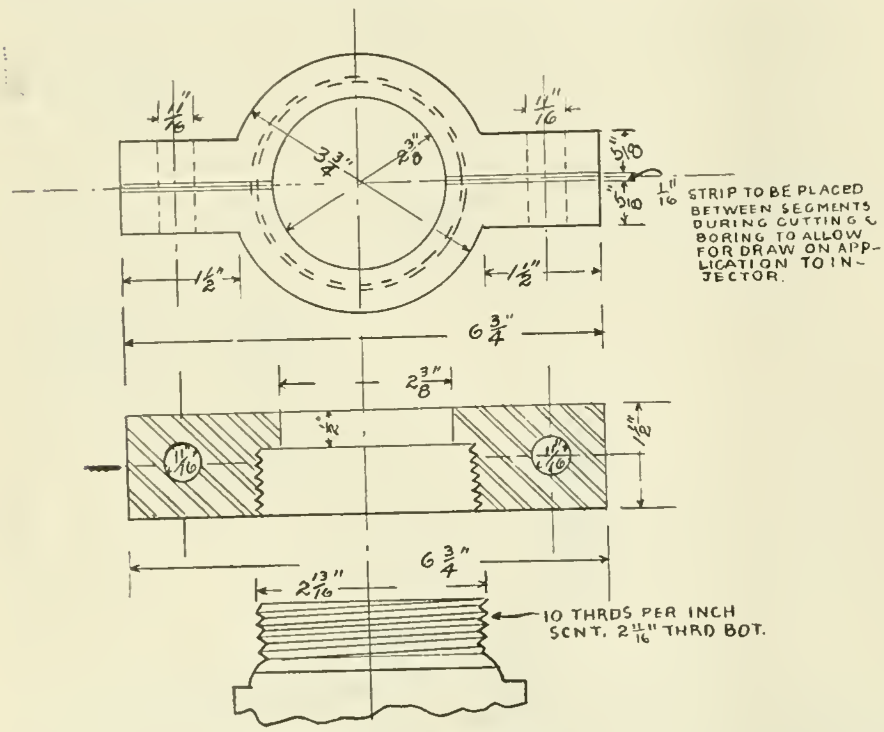
for even hasty repairs before taking her train.

The accompanying sketch is of an emergency nut made in two sections for instant application to the sleeve brazed to the pipe and to the threaded portion on the injector receiving the nut. When an emergency of this kind arises the defect-



EMERGENCY NUT IN PLACE.

ive nut can be slipped up on the pipe; the two sections of the emergency nut applied, bolted together and the joint on the brazing sleeve drawn securely to the joint on the injector. This will prevent a delay to the locomotive until its arrival at the other terminal or division point where the



DETAILS OF EMERGENCY NUT.

defective nut can be removed and the pipe sleeve rebrazed.

A number of these emergency nuts left in the roundhouse office for instant access are a positive safeguard against an engine failure from this source, as they are easily applied by either machinist or engineer.

The sketches are in detail of such a nut for application to the No. 8 and 9 Monitor injectors, but different standards are readily complied with in the construction of this little failure preventing device.

It has been found to be of real value here, and, no doubt, could be of ready service elsewhere.

F. W. Bentley, Jr.,
Machinist, C. & N. W. Ry.
Chicago, Ill.

In Turkey.

Editor:

There are at least half a dozen railroads in Turkey embracing about 1,500 miles of railroad with about 150 locomotives. The roads and equipment were in excellent condition, but the traffic was not large at the time that I was in that vicinity some years ago. Among other features was a colossal shaft or monument in commemoration of the installation of the telegraph, the only thing of its kind, I believe, in any country. I enclose a photograph of the monument and some other views illustrative of Turkish railroads. The progress in railroading in that country has been slow, and the leading men, especially in the mechanical departments, were of other European nationalities. It would not be much of a surprise, in view of recent events beyond the Balkans, if the Turk was driven back to first principles and took to the camel backs again.

L. Lodian.

New York, N. Y.

Rambles in Japan and China.

Among travelers possessing the faculty of seeing things, a gift by no means common, is Mr. Luis Jackson, Industrial Commissioner of the Erie Railroad, who

COLUMN COMMEMORATING THE ESTABLISHMENT OF TELEGRAPH IN TURKEY.

has lately been traveling in Japan and China. He has told the story of his wanderings in a style that is particularly interesting to railroad men. Among other things he said:

"Japan and China are among the most interesting countries I have visited. With the exception of the North Island I traveled through the principal parts of Japan. They have 5,000 miles of railroad in Japan. The gauge is 3 ft. 6 in., mostly single track. The rails are 60 lb., but they are now manufacturing 75 lb. rails in the Japanese steel works.

"The gross earnings of the Japanese railways are fifty-five per cent from passengers, and forty-five per cent. from freight, as compared with twenty-five per cent. from passengers and seventy-five per cent from freight in the United States.

"Japan proper, that is, exclusive of Formosa, Korea, and Saghalien, has an area of about 150,000 square miles, with a population of about 51,000,000 people. The United States, proper, exclusive of Alaska and insular possessions, has an area of about 3,000,000 square miles, with a population of about 95,000,000.

"These figures will show at a glance that the density of population in Japan accounts for the heavy passenger receipts as compared with freight. Passenger and freight rates in Japan, as in nearly every country in the world, are in conformity with surrounding economic conditions.

"The Japanese are very fond of traveling. All the trains are crowded. The

passenger coaches are about 35 feet long, with a center passage right through the train. The seats are on the sides, the same as in our street cars. About ten or twelve of these coaches are pulled by a small engine of English type.

"An average train of ten cars would be made up of, say, nine third class coaches and one combination first and second class coach, in which there is a division between the two classes. Just under the windows on the outside of the car, there is painted a 4-inch band—white, blue or red. White means first class, blue second class, and red third class. The foregoing is the equipment of ordinary trains, from which it will be seen that first class passengers are few. The third class coaches have a very narrow seat around the sides, and in many cases this can be let down, as the Japanese do not use chairs, but squat on the floor. There are no chairs in Japanese houses.

"In addition to the ordinary trains, there are trains on which an extra fare is charged, such as express trains, trains de luxe, with parlor cars and sleeping cars. Every long distance train has a dining car.

ALEIH RAILWAY STATION, TURKEY.

"Everything American or European in Japan and China is called 'foreign.' The dining cars have foreign cooking almost exclusively; that is, French cooking, but on some there is a compartment where Japanese food is served.

"The train crew comprises about the same number of men as our own. Engineers, firemen, conductors and brakemen are all Japanese.

"There is one trainman who is a sort of under-brakeman. He is called 'Boy,' and the English word 'Boy' is in gold letters on the collar of his coat. He performs the duties of a porter and assists the brakemen. For instance, he sweeps out the car, closes windows when the train is approaching tunnels, and, in general, looks after the comfort of the passengers. All these 'boys' speak English, or what they think will pass for English, and I never saw young men more anxious to learn English. All the young Japanese railroad men are expected to study English.

"The Japanese themselves are a most courteous people, and this is noticed throughout the railway service. When I reached some of the larger towns, and found they were division points on the railroad, just before departing I made it a point to call on the superintendent to present my compliments. The clerk at the Information Bureau could generally speak a little English, and introduced me. Some of the superintendents could speak English, and some could not, but by their motions and bows they showed that they highly appreciated an American railroad man's calling on them. The steamer ticket which I bought was interchangeable; one could go from port to port on the steamer, or had the option of going by rail.

"A man can learn enough German on a sojourn in Germany of about three months, to help himself linguistically, but this is impossible in Japan. It would take a man over a year to learn to speak Japanese so that he could conduct even an ordinary conversation, so I did not attempt any acquaintance with the Japanese language, whatever, except to find out what the word 'railroad' was, and that is 'tetsudo,' and the word 'company' is 'kaisha,' while 'Americano' is generally understood to mean American. At times where there was a 10-minute stop and the Station Master was around I said to him, 'Americano,' indicating myself, and he nodded that he understood. Then I said, 'Erie Tetsudo Kaisha,' meaning Erie Railroad Company, and I was greeted with a very pleasant smile and a profound bow, as a fellow railroad man, and on leaving, if he knew nothing more of our language, he always said 'Come again.'

"From the port of Shimonoseki, Japan, I crossed over to Dairen (Dalney) in Manchuria, China, and there traveled on the only railroad in the whole world that is like our American railroads (and they are, fairly speaking, the best. I have been on nearly all the principal lines of the world.) This railroad is called the South Manchuria Railway. It runs from Dairen and Port Arthur, via Mukden to Chang-chun, where it connects with the Chinese Eastern Railway, which runs to Harbin, which is a station on the main line of the St. Petersburg-Vladivostock Trans-Siberian road. The South Manchuria Railway was originally built by the Chinese Eastern Railway Company in 1901, to form an arm of the Trans-Siberian route. The gauge was then the Russian standard of 5 ft., which, however, was converted, during the progress of the Russo-Japanese war, into the Japanese standard of 3 ft. 6 in., to be adapted to the rolling stock sent over from Japan, but when the South Manchuria Company took over the railway from the Japanese Government in 1907, the narrow gauge system was widened into the standard gauge of 4 ft. 8½ in. The main line is 450 miles in length, but the branch lines bring the total mileage up to a little over 700 miles. The rail is 75 and 90-lb. This railway has no freight cars under 60,000 lbs. capacity, and quite a number of 100,000 lb. capacity cars. A great deal of the rail is American, so is largely the signaling apparatus, and the large locomotives are made by the American Locomotive Company at Dunkirk, N. Y., on the Erie Railroad. I was very much tickled when I saw this outfit. The freight cars are all American manufacture, and the passenger coaches and Pullman sleepers are American and as fine as anything in America. This railway company, being financed largely by Japanese capital, and having rights from the Chinese Government, is manned entirely by Japanese.

"Port Arthur is 40 miles from Dairen on a branch which connects with the main line. I went to Port Arthur, hired a guide and from an eminence took in what was the scene of the great siege of 1904. I took command myself and conducted operations all the way from 203-metre hill to Eagle's Nest, but this is another story.

BRIDGES OVER THE DOG RIVER, TURKEY.

"I took the South Manchuria Railway to Mukden. Here I stopped over and a guide pointed out the battlefields. I field-marshaled the job, captured the Japanese and Russian armies, and sent them all into useful employment, but this is also another story; from Mukden I went west to Peking on the Chinese Government Railway, called the Peking-Mukden line.

"This is 4 ft. 8½ in. gauge, with first, second and third class coaches, and with a dining car for foreigners and another car with a kitchen, where the Chinese could go in and cook their food. In many of the third class cars there are no windows during the summer months, and the openings are very large. One can also walk through the train from end to end. On this line a first-class sleeping car train is run to connect with the Trans-Siberian express. The Chinese third-class coaches have regular seats, as the Chinese have chairs in their homes.

"It is about 500 miles from Mukden to Peking. Half way down is the town of

Shanhaikuan on the coast of the Gulf of Pechili. I stopped off there. This is where the great Chinese Wall starts up from the sea. I walked up the slope and on to the Wall. My Chinese guide was a good sprinter and we walked about a mile on the Wall. It runs from Shanhaikuan for 2,500 miles into the interior, ending in Turkestan. It is about 20 to 30 ft. high and 15 to 25 ft. wide; a sort of earth embankment bricked up at the sides like a fortification. It climbs over mountains and dips into ravines, and every few miles there is a military guard house, which was formerly occupied by soldiers. The Wall was completed in the year 211 B. C., and is said to have taken ten years to build.

"From here I took the train to Peking. This is a most wonderful city. China has at present (1912) between 3,000 and 4,000 miles of railway in operation, almost entirely standard 4 ft. 8½ in. gauge. The great main lines constructed are from Mukden to Peking, about 500 miles, and from Peking through the interior to Hankow, a distance of about 800 miles, then there is a road from Peking to Tientsin, and from Tientsin to Pukow, opposite Nanking; also a railroad from Shanghai to Nanking and a great railroad is being built from Canton to Hankow. In course of time travelers will be able to go from Canton to Peking by rail.

"They are talking of building 100,000 miles of railroad in China, and I am certain that this will be a paying investment from the very start. They will not have to do what we had to do in America, build railroads and at the same time create the business for them."

Old-Time Railroad Reminiscences.

By S. J. Kidder.

To the average individual 13 is not a number to conjure with, but years ago, when upon entering the service of the B. & M. R. R. R. in Iowa, I was given a Manchester engine bearing that timorous number, and it did not seriously shock my nervous system, though it may be possible the generally assumed significance of the numerals was instigated by the name of the president of the road, "J. M. Forbes," displayed in bold letters, surrounded by a mass of elaborately colored scrolls, in the sides of the tender. Shortly after, however, when I was slated to go over a division of the road that neither the fireman or myself had ever seen, I began to wonder if there wasn't something prophetic in the number after all. To start out, running wild, with a full train of loaded freight cars provided with hand brakes only, over a division abounding with heavy grades and sharp curves which obscured the view ahead and running second section to a similar train, seemed hardly compatible with good luck, but such was the experience of the writer a few days following his assignment to the No. 13. I had made two trips over the East Iowa division when an order came to go west, where I was to take a construction train, and as the work would be near the other end of the division the train was given us to take along in lieu of proceeding there with a light engine which, in the latter event, would be earning nothing for the company exchequer.

As already stated, the fireman and myself had never been over the 115-mile division, the head brakeman, who was to act as pilot, had been on the road but a few days, while the names of the rear brakeman and conductor had appeared on the payroll but six weeks before. At the time my experience in climbing grades was quite limited and with a somewhat poor steaming engine we stalled near the top of the first hill and were obliged to double at an expense of considerable time and fuel, and after covering forty-eight miles reached Russell, with the coal pile depleted to the extent that a fresh supply was imperative to take us seven miles to Chariton, the nearest coaling station.

Fortunately, "Dad" Stout with the "Seminole" stood on the side track waiting for us to pass and who, upon learning of our predicament, furnished the needed supply, himself helping in the transfer of black diamonds from one tender to the other.

For a few hours following our departure from Russell everything moved along in a harmonious way, but as we approached Murray darkness overtook us and as the 24 miles of road from that place to Creston, the end of the division, was a constant succession of heavy down and up grades, one station far down in a valley, another on the summit of a high ridge, with no semaphores or other safety devices for a guide, the prospects were anything but encouraging to a new man to be dropped down one grade or taking a run for another with no means of knowing where to look for tail lights or when he was likely to find them. Fortune favored us, however, to the extent that we reached our destination in safety late that evening, but the excitement incident to and anxiety during the trip had been so intense that when I stepped from the engine I was nearly worn out. Proceeding to the hotel the culinary department was found closed, it also being learned that the town had no lunch rooms, and so far as sleeping facilities were concerned nothing but standing room or a chair was available. With a feeling of disgust for things in general I returned to my engine, from which was procured the seat cushions, and going to the roundhouse placed them on the floor, with a block of wood under the end of one for a pillow, and retired for the night.

Then began in my mind a review of the events of the day, though I could not hold the 13 responsible for the adverse circumstances, as she had taken me safely over the road, and my reveries led to the conclusion that the attractions of railroading in the West were not as I had heard them depicted and before falling off to sleep I had firmly resolved to take the first eastbound train on the following day and, once started, permit nothing to impede my progress until I was again back in my New England home.

But I was young, tough and hearty in those days and in the morning, following a good night's sleep and breakfast, I again analyzed the situation, finally deciding to tackle the construction train, and if things moved along faily well work a month or two then return to my native heath, but that resolution never materialized, as some eighteen years passed by before I left the service of the company. Later in the day a train of flat cars was made up with a box car, facetiously termed a "bouncer," for a caboose and we pulled out for Thayer, which was to be our headquarters during the season of construction work. About one-third of a mile from the station was a large gravel pit, a track leading from the station to it, and I was assigned to the work of putting in empties and pulling out loaded cars, which proved a decidedly soft snap, as all lading was done by hand and but five or six trains could be loaded per day.

Even under these conditions I was getting full time with a frequent quarter of a day overtime and with a living expense of less than twenty dollars a month; the job very quickly became an attractive one. For a time the only grievance I had was that of more or less friction with a roadmaster, a big, burly Dutchman, Charley Manholtz by name, who had charge of the railroad operations at Thayer, and his assistant, who acted in the capacity of yardmaster, and whose delight seemed to be to annoy the engine and trainmen there, on the slightest pretext, report them to the roadmaster. As to myself, the Dutchman had made it known that "he was after that Yankee running the 13 and would get him." Not long after hearing of this I was detailed to go to Woodburn with a train of empty flats, where they were to be loaded with cordwood then taken to Creston. The trip was to be made on Sunday, because on that day no work would be going on in the pit and we were assured of a clear main track, as no trains were scheduled on the Sabbath.

As the sequel, however, which gave the Dutchman his looked-for chance, and what come of it, is, properly speaking, a story by itself, the readers of Railway and Locomotive Engineering will have to wait another month until they learn the conclusion of the good or bad fortune that came to me while running the 13.

Mikado Type Locomotives for Atlanta, Birmingham & Atlantic

The Atlanta, Birmingham & Atlantic Railroad has recently placed in service five Mikado type locomotives which were built by the Baldwin Locomotive Works. These engines exert a tractive force of 45,000 pounds; the ratio of adhesion is 4.17, and with driving-wheels 57 in. in diameter they are specially fitted for heavy slow speed service. In accordance with the latest practice for locomotives of this type, they use highly superheated steam.

The most interesting feature, in this design, is the boiler, which is fitted with the Gaines type of firebox and combustion chamber. This style of furnace originated on the Central of Georgia Railway, and the results thus far obtained with it have been highly satisfactory. Not only has there been an economy in fuel consumption per ton mile, but failures due to boiler troubles have been largely reduced and there has also been a marked reduction in the amount of smoke emitted when using high volatile coal.

As applied to the new Mikado type locomotives, the firebox is 134 ins. long by 84 ins. wide, and is not unlike the Wooten type in shape. The actual length of the grate, however, is only 89 ins. Firing is accomplished through two circular doors, placed 36 ins. apart transversely; and a power grate shaker is applied. The front part of the furnace is used as a combustion chamber and is separated from the rear part by a brick wall. Provision is made for discharging pre-heated air, in a backward direction at the top of this wall. This aids in the combustion of the gases, and because of the manner in which the air is discharged from the wall, keeps the rear of the firebox filled with flame, thus increasing the effectiveness of the crown and back sheets as heating surface. Any cinders which accumulate in the combustion chamber can be readily removed through a cinder chute.

The superheater is of the Schmidt top-header type, composed of 32 elements. Steam is conveyed to the steam chests through outside steam pipes. The distribution is controlled by inside admission piston valves which are 13 inches in diameter. The Baker valve gear is used, and reversing is effected by the Ragonnet power gear. This device has been applied by the builders to a large number of locomotives of various classes, with most satisfactory results.

The frames are steel castings, 5 ins. wide, with single front extensions 11 ins. deep under the cylinders. Transverse braces of cast steel are placed at the first, second and third pairs of driving pedestals, and also back of the fourth pair where the rear frames are spliced to the main frames. The rear truck is of the Hodges radial type, with outside journals.

The tender has a capacity for 7,500 gallons of water and 12 tons of coal. The frame consists of 12-in. channels, and the trucks are of the equalized pedestal type with standard rolled steel wheels.

The principal dimensions of these locomotives are as follows:

Track gauge—4 ft., 8½ ins.

Cylinders—24 ins. x 30 ins.

Valves—Balanced Piston.

Boiler—Type, straight; material, steel; diameter, 76 ins.; thickness of sheets, ¾ ins.; working pressure, 175 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 134 ins.; width, 84 ins.; depth, front, 68 ins.; depth, back, 65½ ins.; thickness of sheets, sides, ⅜ ins.; back, ⅜ ins.; crown, ⅜ ins.; tube, 9/16.

Water Space—Front, 4½ ins.; sides, 4 ins.; back, 4 ins.

Tubes—Material, steel, and iron; thickness, No. 9 W. G., No. 11 W. G.; number, 32, 234; diameter, 5⅜ ins., 2 ins.; length, 17 ft. 8 ins.

Heating Surface—Fire box, 210 sq. ft.; tubes, 2,946 sq. ft.; total, 3,156 sq. ft.; grate area 51.9 sq. ft.

Driving Wheels—Diameter, outside, 57 ins.; center, 50 ins.; Journals, main, 11 ins. x 12 ins.; others, 10 ins. x 12 ins.

Engine Truck Wheels—Diameter, front, 30 ins.; journals, 6½ ins. x 10½ ins.; diameter, back, 40 ins.; journals, 8 ins. x 14 ins.

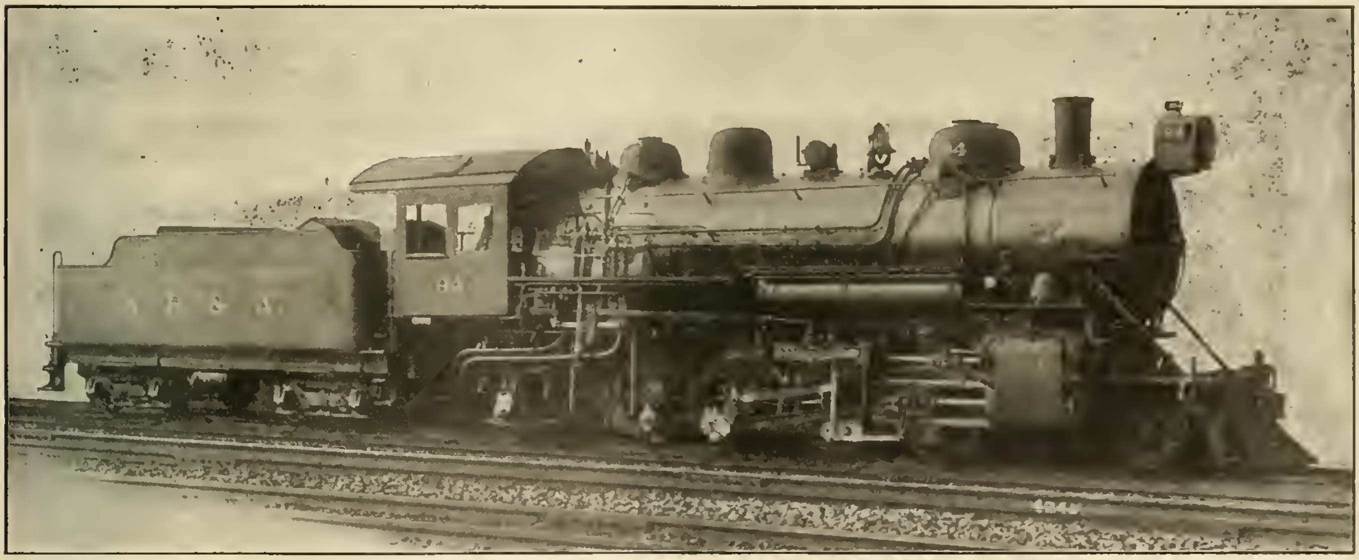
Wheel Base—Driving, 15 ft. 0 ins.; rigid, 15 ft. 0 ins.; total engine, 32 ft. 4 ins.; total engine and tender, 64 ft. 11 ins.

Weight—On driving wheels, 187,700 lbs.; on truck, front, 27,300 lbs.; on truck, back, 34,900 lbs.; total engine, 249,900 lbs.; total engine and tender, 390,000 lbs.

Tender—Wheels, number, 8; diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7,500 gals.; fuel, 12 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 663 sq. ft.

Gaines Firebox—Size of grate, 89 ins x 84 ins.



MIKADO TYPE LOCOMOTIVES FOR THE ATLANTA, BIRMINGHAM & ATLANTIC RAILROAD.
J. F. Sheahan, Supt. Motive Power. Baldwin Locomotive Works, Builders.

Radial Valve Gears.

It is a mistake to supose that radial valve gears, which are attaining decided popularity in this country, are anything new. We believe that Herman Winter's radial and rotary valve gear, as fitted to the Stevens' long toe cut-off was invented and applied in 1856. This gear has been extensively used on the engines of American steamers and is still in service

Catechism of Railroad Operation

Questions and Answers.
Second Series.

(*Continued from page 55.*)

14. (a) When train is ready how should engine be started, and what should be observed? If necessary to take the slack of the train, how should it be done?

(b) After engine has been started how can it be run most economically?

(c) How should water be supplied to the boiler?

(d) What do you consider the abuse of an engine?

Ans. 14 (a) The engineer should see that all switches are lined up and that everything is clear. The lever should be placed in full gear with cylinder cocks open if the location permits, he should ring the bell and open throttle slowly, endeavoring to start one car at a time. If necessary to take the slack, the slack on the whole train should be taken. He should look for signal from rear when train has been started.

(b) As soon as the speed will permit the reverse lever should be hooked up and the throttle and reverse lever worked in such a position as will enable the engineer to get the best possible results, he should be governed by the class of service and the location of the road always working the steam as expansively as the conditions will permit.

(c) On through runs water should usually be supplied in keeping with the manner in which it is being used. On local runs where many stops are required there should be a sufficient amount of water in the boiler when pulling out of a station to permit shutting off the injector. In switching and standing around stations the water should be supplied to the boiler a little at a time, maintaining a good bright fire.

(d) Improper firing, improper use of the injector, blower, improper use of sand, slipping the engine, working the engine unnecessarily hard, improper inspection or booking of work, improper lubrication and improper use of the brakes.

Q. 15. If the check valves were stuck up, how would you proceed to get them down; how with the globe valve attachment?

Ans. 15. First open the heater valve and drip pipes in order to relieve any pressure from under the check, then tap the check case slightly, sometimes pouring cold water on the check case may possibly assist in getting it down. Where a globe valve is used, the globe valve can be closed, then start the injector, allowing the water to flow out through the overflow, then open the globe valve, when the water will pass on into the boiler.

Q. 16 (a) Name the different draft appliances in the front end of a locomotive and explain how you would adjust them to regulate the burning of the fire.

(b) What leaks in the front end will affect the steaming qualities of the engine?

(c) Why should all joints in the smoke arch be kept tight?

Ans. 16.(a) The exhaust nozzle, diaphragm plate, petticoat pipe and sleeve. These are sometimes called draft pipes, and in some cases are all in one piece. By reducing the size of the nozzle tip makes the draft sharper on the fire, by increasing the size causes the draft to become milder. raising the diaphragm plate increases the draught through the upper rows of tubes and back end of firebox. Lowering the diaphragm plate increases the draught through the lower rows of tubes and front end of firebox. Raising the petticoat pipe and lowering the sleeve has the effect of increasing the draught all over the fire and moving them in the opposite direction has the effect of reducing the draught. Lowering the sleeve produces the same effect as raising the diaphragm plate. It must be understood, however, that there is a limit to the effect that any one of these movements will have on the fire.

(b) Leaky steam pipes, either bottom or top, the nigger head joint leaking, exhaust pipe joints, either bottom or top; blower pipe or exhaust pipe from pump leaking, front end of flues or washout plugs.

(c) In the event of leaks in the front end it has the effect of destroying the vacuum and affecting the steaming qualities of the engine, also the oxygen from the air coming into contact with the small particles of carhon at a high temperature causing them to ignite and burn, thereby warping the front end sheets.

Q. 17. In the event of the blower becoming disconnected how could you create a draught on the fire?

Ans. 17. By causing a leak in main drum pressure thereby causing the air pump to continue to work, providing, however, that the exhaust from the pump is placed in the smoke arch. The main steam valve in the pump can also be removed, or in the event of not being able to use the pump in any manner the valve rod can be disconnected, the valve moved ahead or back until the exhaust port is slightly uncovered, then by opening the main throttle valve steam will pass out through the exhaust nozzle and stack creating a draught on the fire.

Q. 18. (a) What is the difference between priming and foaming of water in a boiler?

(b) What would you do in case of foaming?

(c) What is the danger when water in boiler foams badly?

Ans. 18 (a) A boiler is said to be priming when the water in the boiler is sufficiently high so that sprays of water are drawn over through the throttle valve passing down into the cylinder. When a boiler is foaming the entire body of the water is mixed with bubbles similar to that of soap suds. This causes the water to appear much higher than it really is. Foaming is usually caused by impurities in the water such as alkali or vegetable or animal oils.

(b) When the engine foams badly the cylinder cocks should be opened, the reverse lever worked at longer point of cut-off and the throttle closed gradually in order to locate the correct water level, put on both injectors if necessity requires it. It is also good practice to increase lubrication.

(c) The danger when boiler is foaming badly is of knocking out cylinder heads. breaking packing ring, bending piston rods, destroying lubrication and last but not least of burning the crown sheet.

Q. 19. Suppose you shut off and the water in the glass dropped out of sight, what would you do?

Ans. 19. In the first place when an engine is foaming badly the throttle should not be closed entirely until the proper location of the water is ascertained. However, in the event of the water passing out of sight the lever should be hooked up on the center, throttle opened, gauge cocks tested in an effort to locate the water. If the water cannot then be located I would protect the firebox by knocking or banking the fire.

Q. 20. Suppose a washout plug blew out or a blow off cock broke off or would not close what would you do?

Ans. 20. Unless the washout plug could be replaced by an iron one of some kind I would consider the engine a subject to be towed in. As soon as this happened,

however, I would put on both injectors and protect my fire so that no damage might be done to the firebox. The same rule would apply to a blow off cock broken off, but in the event of a blow off cock sticking open I would put on both injectors and endeavor to get the blow off cock closed.

Q. 21. Suppose the whistle or one of the safety valves blew out what would you do?

Ans. Put on both injectors and endeavor to hold the water to a safe level and if the surrounding conditions permitted place a wooden plug in the hole holding it down by a timber across the hand rails tying it down.

Q. 22. What would you do if one of the safety valve springs broke?

Ans. Screw down the adjusting screw and put that safety valve out of business if possible. If this is not successful reduce all the pressure, remove the adjusting screw and drop a small nut or bolt and then replace the adjusting screw, screwing it down until the safety valve is out of commission. To carry out the last method it would be necessary to reduce the pressure.

Q. 23. What would you do if the packing blew out of the throttle stuffing box?

Ans. Would screw up on the gland as tight as possible placing the back curtain in order to protect the fireman and bring the train in if possible. If it became necessary to pack I would take siding, reduce all the pressure and pack it with whatever material could be obtained.

Q. 24. What causes engine failures and what would you do to prevent them?

Ans. Aside from mechanical defects engine failures are frequently caused by the failure of someone to do the proper thing at the proper time. In order to prevent them the engine should be inspected not only at the terminals but at every opportunity and the work properly booked, the engine should be properly fired and all nuts and bolts kept tight.

Q. 25. What attention should be given to boiler attachments such as gauge cocks, water glasses, etc.?

Ans. Gauge cocks and water glasses should be kept well packed. The water glass should be changed frequently, they should be blown out thoroughly each trip and see that they register the proper water level.

Q. 26. How would you manage with a burned or broken grate, how if entirely gone with a deep ash pan?

Ans. In the event of one section of a grate being broken or burned with a shallow ash pan it may be bridged over or if broken blocked up from underneath. If grates are entirely gone especially with deep ash pans the fire should all be knocked out, the pans hoed out and the engine prepared to be towed in.

Q. 27. If engine was throwing fire badly to what would you attribute the cause and what would you do to prevent it?

Ans. This may be due to the holes in the netting or to the manhole door in the front end being loose. This may be eliminated by working the engine as lightly as conditions will permit, keeping the coal well wet down, opening the door slightly and in some instances carrying a heavier fire. If there is much danger attached, the front end door might be opened and the netting patched. It is also advisable sometimes to notify the proper officials.

Q. 28. What should be done with a badly leaking or burst flue?

Ans. 28. If the burst flue is in a position where it can be gotten at it may be plugged by a hollow plug. In the event of the flue being burst in such a manner so as to require plugging from both ends the Interstate Commerce rules covering boiler inspection requires that hollow plugs should be used in both ends and a rod running through the entire length of the flue with nut on both ends.

Q. 29. How would you proceed to set up wedges; and how would you know if one was stuck; and in what manner would you proceed to pull it down?

Ans. Where wedges are to be set up all around would place engine on forward top eighth on right side place lever in forward position which will admit steam to the back end of both cylinders. This will move the boxes against the shoes permitting the wedges to be set up. The driver brake should be cut out and the brake set on the tank or the tank blocked. The method of handling the wedge bolts must be governed by the class of wedge bolts used. It is customary, however, to pry the wedges up as far as they can be raised then slacking down about an eighth of an inch, tightening the jam nuts properly. The indications of wedges being stuck is that it will cause the engine to ride hard and the pedestal jaws will not move up and down on the box while the engine is moving. To locate which one is at fault place the coal pick or something of that kind on the rail running the engine over it. This will usually jar it loose. Sometimes it can be pulled down with the wedge bolt if it is not stuck too tight.

Q. 30. What position would you place engine to properly key up main rod brasses?

Ans. Would place engine on forward top eighth to key up the back end of the main rod and on bottom quarter or bottom back eighth to key up the front end. In this position the brasses are supposed to be pressing against the largest diameter of the pin, also the weight of the rod is inclined away from the pin.

Q. 31. (a) How would you key up side rod on eight or ten wheel engines? Do you fully understand the necessity of keeping rods keyed up properly? Explain.

Boiler Inspection.

Mr. Ensign, the chief Federal boiler inspector, is having issued full instructions in regard to the inspection of boilers from which it appears that all staybolts must be tested at least once each month, and also after every hydrostatic test. The inspector must tap each bolt and determine the broken bolts from the sound or the vibration of the sheet. If staybolt tests are made when the boiler is filled with water, there must be not less than 50 pounds pressure on the boiler. Should the boiler not be under pressure the test may be made after draining all water from the boiler, in which case the vibration of the sheet will indicate any defect. The latter case is considered preferable. It is further specified that no boiler shall be allowed to remain in service when there are two adjacent staybolts broken or plugged in any part of the firebox or combustion chamber, or when three or more are broken or plugged in a circle four feet in diameter, or when five or more are broken or plugged in the entire boiler. It is required that all staybolts shorter than 8 inches, except flexible bolts, must have telltale holes 3/16 inch in diameter and not less than 1¼ inches deep in the outer end, and that these holes must be kept open at all times. Now the important point to be determined by the inspector in these staybolt tests is whether or not the staybolt is broken, and herein there is a chance for a difference of opinion. Some inspectors hold that when a staybolt is cracked part way through it is a broken staybolt and should be removed, while others claim that the bolt is not broken unless it is fractured at least half way through or up to a point where the failure is indicated by the telltale hole. There is certainly some latitude for decision on this point, but there should be a well defined rule to cover the case, so that no dispute can arise as to a bolt being broken.

Mallet on Compound Locomotives.

We recently found a French pamphlet on Compound Locomotives, being a translation into French by Mr. Anatole Mallet of a paper read by Angus Sinclair at the New England Railroad Club. The popularity which the Mallet compound locomotives have attained in this country stimulates interest in the pamphlet referred to. The paper was a plain statement of what compound locomotives were and how they operated. Mr. Mallet commends the paper very highly and says, although it is short, it is very clear, precise and impartial. He adds a number of notes commenting on statements made in the paper and publishes engravings illustrating the valve arrangement of compound locomotives of his design.

Questions Answered

DUCTILITY OF STEEL.

251. G. T. S., Deer Lodge, Mont., writes: Our cabooses are built with continuous steel draft rigging and steel underframes for the purpose of heavy power being used behind as helpers on mountain grades. Will the steel parts above mentioned be weakened by having been bent and distorted through accidents or wrecks, and then heated and put back into the original shape? As an example, if in collision the draft rigging and underframe had been bent upwards, and then heated and straightened back as is done at repair points on the average railway by the repair men, will these parts withstand as much shock without injury as before? A. The ductility of good steel has the admirable quality of retaining its tensile strength after being bent or twisted, and in many instances is improved on account of the fact that when metal is rolled or hammered it assumes a stringy or fibrous form similar to fine grained wood. As soon as it is cooled it begins slowly to assume its original crystalline form and becomes, after a long period, to have a greater degree of brittleness. When heated it again assumes much of the fibrous form. Hence reheating the metal improves its elasticity. For this reason chains and other appliances are occasionally reheated or annealed, which improves their durability. In the cases of bent or twisted pieces the heating process will readily demonstrate whether any cracks have occurred, and care should be taken that the pieces to be straightened should be heated to nearly a white heat, as there is an aptitude in temporary repair work to straighten metals at a low degree of heat, which is apt to induce fracture. What is known as the "fatal blue heat" is peculiarly apt to induce fracture. This is particularly noticeable in flange work on boilers when the bending process is continued too long.

PRESSURE ON BOILERS.

252. J. J., Laurel, Mont., asks: What is the pressure against the entire surface of a boiler carrying 200 pounds of pressure to the square inch? Would it not be the number of square inches of surface multiplied by 200 pounds? A. As the pressure is equal on all parts of the boiler, the total amount of pressure would be the total area multiplied by the pressure, but the effect of such pressure is subject to important variations, the cylindrical part of the boiler being capable of much greater resistance than the square or oblong portions. The temperature also affects the resisting quality. Many tests have shown that the tensile strength of steel diminishes as the temperature increases from 0 deg. until a minimum is reached between 200 deg. and 300 deg. Fahr., the total decrease being about 4,000 pounds per square inch in the softer steels, and from 6,000 to 8,000 pounds to steels over 80,000 pounds tensile strength. From this minimum point the strength increases up to a temperature of 400 deg. to 650 deg. Fahr., the maximum being reached earlier in the harder steels, the increase amounting to from 10,000 to 20,000 pounds per square inch above the minimum strength at from 200 deg. to 300 deg. From this maximum the strength of the steel decreases steadily at a rate approximately 10,000 pounds per 100 deg. increase of temperature. The subject is very fully treated in Kent's Mechanical Engineer's Pocket Book.

VIRGINIAN AND SANTA FE MALLETS.

253. A. G., Chicago, Ill., writes: How does the mammoth Mallet on the Virginian Railway described and illustrated in the February issue of RAILWAY AND LOCOMOTIVE ENGINEERING compare in size with the largest of the Mallets on the Santa Fe Railroad, and are they both of real practical value? A. In the matter of weight the Virginian Mallet constructed by the American Locomotive Company has a total weight of engine and tender of 744,000 pounds, having a total wheel base of 91 ft. 5 3/16 ins., and a heating surface of 6,828.2 sq. ft. The cylinders are 28 ins., and 44 ins. in diameter, with a piston stroke of 32 ins.

The largest of the Santa Fe Mallets constructed at the Baldwin Locomotive Works has a total weight of engine and tender amounting to 850,000 pounds, with a total wheel base of 108 ft. 4 ins., and a heating surface of 6,557 sq. ft. The cylinders are 28 ins. and 38 ins. in diameter, with a piston stroke of 32 ins. The Virginian Mallet has a working pressure of 200 pounds per square inch, and the Santa Fe Mallet a pressure of 225 pounds. Both are of real practical value, and are doing the work of two of the engines of the classes that they superseded at much less expense.

DOES IRON EXPAND IN COOLING?

254. M. Y. Hornell, N. Y., writes: A party of us was talking shop at lunch time and the statement was made that cast iron followed the same law as ice follows in solidifying, that is, expands. The idea is plausible enough, but I can find no authority for it in engineering books. Can you enlighten searchers after knowledge? A. There is no doubt that all substances in changing from the liquid to the solid expand. We cannot quote any authority on the subject, but one of our private memoranda says that Mr. Whitney, the famous wheel maker, asserted at a meeting of the New York Railroad Club that cast iron expands in solidifying.

METAL POLISH.

255. H. B. T., Savannah, Ga., writes: I recall seing a formula published in RAILWAY AND LOCOMOTIVE ENGINEERING some years ago giving details of a mixture for polishing head-light reflectors. Would you kindly re-publish the directions for the benefit of a number of railway men here? A. We have occasionally published formulas of this kind, but we have found by experience that there are others who are more fully qualified, not only to furnish a formula, but to furnish the compound itself. The Geo. Wm. Hoffman Co., Indianapolis, Ind., have earned an enviable reputation in supplying metal polish that has not been excelled.

RAILWAY TUNNELS.

256. A. F. R., Kansas City, Mo., asks: Where are the longest railway tunnels in America to be found? A. Gunnison, Southwestern Colorado, 6 miles. Hoosac, Hoosac Mountains, Massachusetts, 4¾ miles. Cascade Mountain, through the Cascade Mountains in Washington, 3 miles, unfinished. St. Clair, under St. Clair River from Sarnia, Ont., to Port Huron, Mich., 2 miles.

ORDINARY EXPANSION.

257. John B., Newark, O., asks: Which will expand the most in length at equal temperature, a piece of iron one inch diameter and one foot long, or a piece two inches diameter of the same length? A. If the quality of the iron is the same the expansion will be equal.

THROW OF ECCENTRICS.

258. F. L. B., Elizabeth, N. J., writes: I am making a small engine and I am puzzled how to make an eccentric with 3 inches throw. Can you help out an admirer of your paper? A. Turn a disk and then lay out and bore a hole 1½ inches off the center of the sheave and it will produce 3 inches throw.

TO BLACKEN BRASS.

259. Machinist, Terre Haute, Ind., asks: Please give me a recipe for something that will turn brass glossy black. A. A black lacquer for brass is made of one part nitrate of tin to two parts of chlorine of gold. The article to be lacquered should be finely polished to begin with, then washed with the mixture. After fifteen minutes wash clean with water.

SIZE OF EXHAUST PORT.

260. W. E. F., Carbondale, Pa., writes: In decreasing the size of preliminary exhaust ports of G 6 and H 6 brake valves, and using larger size equalizing reservoirs, what gains are

made. Why is this not too much like "loafing on lap," in giving the train line leaks to get in their work before the exhaust piston raises? A.—Reducing the size of the preliminary exhaust port to 1-16 of an inch does not delay the time of a service reduction. The old method of fitting equalizing piston rings has been abandoned; that is, the ring of the G6 brake valve was rather heavy, fitting tightly in the bushing so as to give a certain stability to the movement of the piston and was regarded as a friction ring rather than a packing ring, and with the loose fitting piston there was considerable leakage from the brake pipe into the equalizing reservoir. While the handle was in service position, and the reduction from 110 to 90 lbs. in the equalizing reservoir required from 5 to 6 seconds time. With the neat-fitting piston and packing ring of the H6 valve the pressures are practically separated and it was found that in some cases the rate of reduction through the 5-64 opening was faster than from 5 to 6 seconds with a tendency to produce undesired quick action, hence the 1-16 opening in the preliminary exhaust port bushing which again brings the rate of reduction back to from 5 to 6 seconds, and from 70 to 50 lbs. in from 6 to 7 seconds.

WORN VALVE BUSHING.

261. W. E. F., Carbondale, Pa., writes: The piston valve packing rings of a Westinghouse 8½-inch cross compound compressor have an opening of an average of 1/32 of an inch and the bushing is not worn. Air end of the pump has been examined and nothing found wrong. Would the reversing valve bushing which was worn 1/32 of an inch in two places cause enough back pressure back of the large piston valve to make the pump run slow? A.—We do not think so. As a general proposition the worn reversing valve bushing results first, in an annoying occasional short stroke of the pump, and finally in a complete stoppage and no appreciable change in the speed of the pump. The slow speed of a pump indicates choked air passages, a restricted steam supply or badly worn steam piston packing rings. A badly worn steam cylinder is in effect equivalent to badly worn rings.

AIR BRAKE SCHEDULES.

262. G. H. S., Northfield, Vt., writes: What is meant by Westinghouse Air Brake schedules A1 plus S. W. A.? A.—Schedule A1 — S. W. A. means the combined automatic straight air brake. The A1 consists principally of compressors of the specified size, a governor, air gauge, G 6 brake valve complete, triple valves, auxiliary reservoirs, and brake cylinders of the proper size, including the necessary drain cocks, air hose and fittings.

Schedule S. W. A. is a straight air equipment for the locomotive composed principally of a brake valve, reducing valve, double check valve and a safety valve

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"Safety First" Movement on the Canadian Pacific Railway.

In order to lessen the number of accidents and to reduce the loss of life and property, a movement has been begun along the whole of the system of the Canadian Pacific Railway for the formation of Safety First Committees. This new policy of the spreading of Safety First work among the employees of the road has been clearly demonstrated by necessity and the idea of teaching the men to endeavor to observe certain rules which it was thought would minimize the number of accidents, was first mooted in the United States, and it has been found to work so admirably that on forty-four railways in America covering 144,139 miles of track, the spread of Safety First work is manipulated by a regular staff and is thoroughly organized, with successful results. The Canadian Pacific always up-to-date in whatever policy it pursues, has been quietly working away at the Safety First Movement for more than a year, and the work is now expanding at a tremendous rate. Literature has been circulated throughout the system and meetings have been held in the East, others are scheduled for Western points, and before very long it is anticipated that the movement will have reached an important stage. Committees are being arranged in various centers where the men are employed in every sphere of railway work and will be instructed to carry out certain rules and regulations which are being compiled by themselves with a view to lessening the dangers of the railway world. This is an employees movement and the railway companies pay the time and expenses of the employees while engaged in this work.

One of the principal objects of the committees is that every employee shall assist his fellow workman, and whenever he observes him doing even the smallest thing that he knows might endanger the life of another workman, or cause some injury, is to set him right, and to remember that "Safety First" is the best motto. It must be remembered that the "chance taker helps to support the artificial limb maker." The following are a few of the resolutions headed "Safety First" which railway men have been asked to make this year:

I will not stand in front of a moving car, or engine, to board same. I will always respect the blue flag because the lives of my fellow employees depend upon it. I will not stand between the cab and the apron when coaling an engine. I will not push a draw bar with my foot, or hands, when cars are moving, or when they are close together. I will not adjust a coupler, turn an angle cock, or uncouple hose bags, when cars are in motion. I will not hold on to the side of a car when passing platforms, buildings, or obstructions close to the track. I will not shove cars into a freight shed, or on team tracks, without first making sure that all men and teams are clear. I will not kick cars into sidings where boarding cars, or cars being loaded, or unloaded, are standing. I believe that Safety First is simply a habit and I will cultivate the habit. I believe that some accidents are not inevitable, and I know the great majority of them can be prevented by care.

Waste in Black Smoke.

This notice has been posted up in many conspicuous places for the information of Erie employees:

Every puff of black smoke from an engine represents so much money deliberately wasted. Coal is a costly factor in railroad operation, and black smoke originates from coal through improper combustion. Perfect combustion eliminates smoke, which when consumed in the fire box, represents an economy, instead of an expense.

The real value of coal—its very vital value—lies in black smoke, and it should be made to count in firing. When black smoke is allowed to pass through the stack, it represents willful waste, just as though the very coal itself were thrown away. Every puff of smoke contains so much carbon and gas, which, when wasted, representes a direct loss of coal. The willful waste of coal, through the emission of black smoke, should be given earnest study, as a measure of economy.

Experts on fuel economy disagree as to the loss entailed through the emission of black smoke from stacks of engines, but they do agree that it is enormous.

The Erie stands among the big losers from this cause. Will Erie engineers and firemen help to lessen it?

When an engine pops it represents a loss of about fifteen pounds of coal per minute. An ordinary observance of common sense will easily prevent it. The result will be a saving of coal, annoyance to a community, and the elimination of legal proceedings, that emanate from the authorities in every municipality where the popping is allowed to prevail.

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The Metric System.

The *Valve World*, which is the house organ of Crane Co., Chicago, is carrying on an agitation in favor of the Metric System of weights and measures being introduced into this country by compulsory or convincing means. It might be entirely satisfactory to the makers of valves to adjust their measurements to the metric system, but nearly all other thriving industries use too many articles of precision that are based on inch measurements to have a change effected without incurring ruinous expense. The *Valve World* is over a century behind the time when a change in our metrology could have been effected without throwing many lines of industry out of gear. The agitation in favor of the metric system has been stirred many times and by personages of commanding influence, but they all ended at the same bank—nothing doing.

The late Hon. Charles Sumner was an earnest advocate of the metric system for some years, and by his influence 15 grammes were legally made half an ounce, but it weighs 10 grains more. Then the legislature stepped in and said, you may call 15 grammes half an ounce if you wish, but you cannot pass it through the mails without extra charge. After his efforts to introduce the French system had thrown the post office into confusion, Sumner discovered that all the grocers and dealers in weighed goods in the country would be required to purchase new scales or have the old ones regraduated. That created such a tumult, that Mr. Sumner abandoned the attempt to reform our metrology.

While objections to the metric system are our theme we will indulge in some historical reminiscences. For many years before the eighteenth century closed, great confusion existed in the weights and measures used in different parts of France and in all continental countries. About the period of the tragic revolution, the urgency for a uniform system became so great that it was pressed upon the attention of the French National Assembly. That was a time when the regeneration of mankind was deeply attracting philosophers. That class was highly powerful in those days, and its members were ready to exude from their inner consciousness, anything from a new religion or government to a new vice, and the furnishing by them of a new system of metrology was a mere bagatelle.

A committee of scientists was appointed to work out the new system of weights and measurements. After protracted deliberation, that committee took for the unit of measurement what they incorrectly calculated to be the forty-millionth of the earth's meridian which passes through Paris. This they called the metre. Its length is a trifle over 39.37 inches. Its divisions and multiples vary in a tenfold ratio. The first division by 10 makes a "decimetre," 3.937 inches; the second division makes a "centimetre," 0.3937 inches and so on, the particulars being well known.

After a long struggle the metric system was forced upon the French people; and other countries having little manufacturing that called for precise measurement adopted it by degrees. Forcing it upon the French people caused several rebellions. All except the people of the British Isles, who objected to having their manufactures thrown into confusion by new measurements adopted the metric system.

If the change to the meter had been made in his country when it was adopted in France, it would have caused little inconvenience, although the inch and foot form a better basis of measurement than the metre; but today there are so many things established on the inch, foot and yard measurements that a change would lead to intolerable confusion. All the land in this great country is divided up into parts measured by the foot or its multiple. To apply the metric system to our town lots alone would lead to a useless amount of figuring that the people would not endure. All scales and weighing appliances are graduated to pounds so that a change would involve no end of confusion and expense that no free people would stand.

But it is when we enter the machine shop and other places where measuring appliances and exact gauges are in use, that we can most thoroughly understand the stupendous nature of the change proposed. For more than a century our mechanics and manufacturers have been laboring on the establishing of interchangeable parts in all lines of machine work, from a typewriter to a locomotive, and all the parts have been duplicated on the basis of inch measurements. There are in our machine shops and factories millions of tools, jigs and formers designed to duplicate existing forms whose sizes are known by inch nomenclature; our standard system of screw threads have details of dimensions known connected by the inch, and the vast plants of machinery designed for the manufacture of screws and their accessories would be useless were existing standards thrown aside.

Many defenders of the metric system say that they do not advocate changing established standards. Let us see how we could apply new names to the old sizes. The successful operating of a machine shop depends in a great measure on sizes being readily understood and easily remembered. When a mechanic examines a drawing, it is of the greatest importance that the size he is going to put into metal or wood should come to his mind readily without study or calculation with marking materials. The fewer figures that he has mentally to grasp in a measurement the less chance will there be for mistake. A common job in a machine shop is to make a bolt 1 7/16 x 6¼ inches with taper 1/16 in 12 inches. A machinist reads this in the drawing, and his familiarity with the two-foot rule enables him to go on with the work without an instant of delay in making calculations.

The metre scale cannot be used in machine shop work, because nearly all measurements are less than a metre, and the use of that scale would lead to no end of decimals. Therefore the millimeter scale is used in all French and German shops. By this scale the bolt mentioned would be described 36.5125 x 158.75 m.m., taper 1.5875 in 304.8 m.m. If the machinist was as familiar with the millimeter scale as most of our men are with the inch scale, it is obvious that the increased number of figures employed would increase the liability to error in the measurement. Where a system of measurement requires many figures, it

prevents people from memorizing dimensions, consequently it requires more time to do work.

The Master Car Builders' and the Railway Master Mechanics' Associations have adopted certain standards whose dimensions have been memorized by the persons having to draw and make them. The few figures required in expressing the dimensions in feet and inches are easily remembered. Put the dimensions into the metric or millimeter scale and memorizing becomes impossible to the ordinary mechanic. Take the M. C. B. standard axle for instance. The total length is 6 feet 11¼ inches. In the metric scale the length is 2 m., 1 dm., 1 cm., 4.57 m.m. Every other item of shop measurement would be subjected to similar strange sounding changes which workmen would learn very slowly. In the process of learning mistakes would be made and delays in getting out work would ensue that would cost the company thousands of dollars.

The enthusiastic advocates of the metric system say that standards would be adopted which would conform to even divisions of the meter. The proposal to change established forms to suit a new unit of measurement is simply absurd, and the men who speak of such a thing merely display their ignorance of the nation's business. Look for an hour through a well equipped tool room. Note the great variety of drills, taps, dies, reamers and gauges that are made to standard sizes; then reflect on the thousands of other shops and factories that have similar equipment and are working to the same sizes. Look at all the lathes in the country, all of them having lead screws designed to cut threads to the inch or fraction thereof. No man familiar with the production of machine parts who has good sense would recommend that a mixed system of manufacture should be introduced into a shop. You cannot have one lathe cutting 8 threads to the inch and another cutting 32 threads to the decimeter, which is the nearest metric unit to the inch, for they will not interchange. The last time the writer was in a French machine shop seven years ago they were still using lathes with Whitworth lead screws, hence cutting Whitworth threads. The superintendent said that it caused *beaucoup de tracasse*, which meant annoyance, but they could not help it.

We have discussed this subject at some length because we have noted that many engineering school graduates are inclined to advocate the metric system without understanding the serious obstacles in the way. The universal use of U. S. Standard screw threads alone will make a change from the inch basis of measurement possible. In a word, while there is nothing to be gained by a change, there is a great deal to lose.

The Mild Winter.

The exceptionally mild winter through which we have almost passed has been of great advantage to railroad traffic, and while the northwest seems to have had some of its usual hard climatic experiences the average weather has been of that California kind that almost breathes of eternal spring. Doubtless the old winters will be back to us in all their fury, but with the growing improvements in mechanical appliances and the better means and methods of clearing tracks, it is not at all likely that the railroad men will ever be called upon to endure the signs of winter under conditions that were so perilous in the earlier days of railroad work.

The story of railroading in winter has never even been begun to be told. The sea with its fathomless furies has had a thousand chroniclers. The seafaring man is a picturesque character, that appeals to the imagination, and during his unattached periods he is a wonderful story teller. The railroad man takes his hardships as a matter of course, and uncomplainingly meets conditions that are inevitable. Winters like the one that is passing however, will be memorable, and when they do come with their serene skies and clear pathways they will always be gratefully appreciated.

The Train Dispatcher.

The questions that come to this office expecting an answer are by no means confined to mechanical or engineering matters, although that is our intention. The latest is from a young man considering a career, who wishes to know who among railroad men occupies the most responsible position?

The writer has done nearly every kind of work on railroads and he used to think that being engineer of a fast express train on a stormy night filled the cup of responsibility; but when his mind has traveled over the entire field, he concludes that the position of train dispatcher on a busy circuit of a single track road is the most responsible to be found.

Upon his shoulders rest greater responsibilities than upon any man in the service. He is under a strain all the time, having to move hundreds of trains on a single track, make them meet and pass one another, moving specials and extras and work trains and steer them all in safety, and at the same time arranging that no time will be lost by any of them, that all connections may be made and to continue that work day after day without making a single mistake that might have fatal results, is a stupendous task.

If you want to know what responsibility means work your way to the train dispatcher's position.

What Americans Have Done for the Locomotive.

It is difficult having honor and credit given to the people whose ingenious labors have successfully carried out important improvements on machinery. Some Americans possess such a small share of patriotism, that they are always looking for some foreign personage to whom they may give credit for achievements performed by their own countrymen. The writer, who is not American born, recently listened to a statement made by an American in a public meeting, that the steam engine was invented and perfected by James Watt, and that the locomotive came from the hands of George Stephenson a perfected engine.

Let us review the work done by the American inventor and mechanic towards developing the locomotive. Take a standard eight-wheel engine, good for almost any kind of service. The high-pressure, high-speed engine itself, so simple and efficient, is the invention of Oliver Evans; the multitubular boiler so essential to rapid steam making, and without which no train could have been kept running more than 10 miles an hour, was invented by Nathan Read, an American. It is carried in compact form by four coupled driving wheels and a four-wheel truck, a combination patented in 1836 by Henry R. Campbell, of Philadelphia, the truck having been previously invented by John B. Jervis, of Rome, N. Y. The driving wheels, of cast iron made hollow, are the invention of Thomas Rogers, of Paterson, N. J., who was also among the first to use weights secured in the wheels to counterbalance the momentum of the reciprocating parts. Allen paper wheels —a thoroughly Yankee notion the invention of Richard Allen, an American—carry the engine truck, and the tender is sustained by cast iron wheels with chilled tread, first invented by Ross Winans, of Baltimore. The single bar frame, holding cylinders placed horizontally and bolted together in the center, is another remarkably strong and compact combination, designed in part by Winans, but put in its present shape by William Mason, of Taunton, Mass. All the pipes and joint connections are secured against leakage by the ground joint, invented by M. W. Baldwin, of Philadelphia. Expansion braces, first brought out by Rogers, give the fire-box a secure hold on the frame, yet permit the boiler to lengthen or shorten, as change of temperature requires. The weight of the engine is distributed evenly to the axle-boxes by means of equalizing levers, invented in 1837 by Joseph Harrison, of Philadelphia. Two fixed eccentrics, invented by William James, of New

York, give movement to an Allen slide valve, balanced by a Richardson device, the invention of George Richardson, who also invented the pop safety valve, the most perfect device ever tried for relieving boiler pressure. The slide valves are operated by Baker-Pilliod motion, and are oiled by a Detroit lubricator. Spark throwing is restrained by an extended smoke-box combination invented by E. M. Reed, once general manager of the New York, New Haven & Hartford Railroad. Combustion is admirably promoted and smoke-making prevented by a perfected design of fire-box, which is constructed of mild steel, first made successful for that purpose by the Baldwin Locomotive Works. The engineer and fireman sit comfortable in a convenient cab, first applied by David Matthews, but since improved by every builder in the country.

As the locomotive thunders along through the blackness of midnight over giddy chasms spanned by traceries of steel, over the dangerous grades of mountain scenery or through the sameness of Western plains, the engineer sits calm and steadfast, secure in the knowledge that engine and train are perfectly under his command. This entire confidence is begotten of the knowledge that a turn of the hand would grasp every wheel in the train between vise-like brake-shoes applied by that greatest life-saver of modern times, the Westinghouse automatic air brake, one of the most valuable parts that the American inventor has added to railroad machinery.

We believe it has the right par excellence to be called the American Locomotive.

Oil Burning Locomotives.

The continued increase in the number of oil burning locomotives in the West and Southwest is the best proof that there are several important advantages derived from the use of liquid fuel on the modern locomotive. The first experiments demonstrated a gain in point of economy of at least 25 per cent. in the cost of fuel. This is subject to variation as to locality, but even if the price of fuel was about equal the improvement in the efficiency of the boiler is everywhere acknowledged where the opportunities for a fair comparison have been afforded.

The burners are now become standard in their form and use and have assumed two simple types, that of outside and inside mixers, each apparently giving satisfaction, indicating that the design of burner is not of very great importance. Brick arches and walls have grown in recent years until the firebox sheets are much better protected from the intense heat than they were in the early experiments with oil fuel, and the deterioration of the sheets is not nearly so rapid as it was some years ago when the sheets were largely exposed to the intense flame, and when patches on the sheets were rapidly burned away.

It has been clearly demonstrated that oil burning locomotives are capable of hauling nearer their maximum tonnage than a coal burner, and particularly in passenger service, maintains the schedule better. This is not only owing to the better steaming quality of the locomotives using oil fuel, but to the absence of delays caused by the use of poor coal, or, rather, foul coal, with its accompanying difficulties in fire grate and front end cleanings. Experience has also shown that there is much to be gained by the intelligent co-operation of engineer and fireman working together, as every change of the throttle valve or reverse lever must immediately be met with a corresponding change in the oil supply and adjustment of the atomizer.

The quickness also with which even the heaviest engines can be made ready for service is also a decided advantage, and the decreased cost of handling at terminals the convenience of taking water and oil at the same time, the complete freedom from fires as shown in the reports of the claim departments are all matters that speak loudly in favor of the oil burners.

At the same time the reports of expenses in the mechanical departments have increased. The flues are subjected to a more rapid decay than in coal burning locomotives, and portions of the firebox have also to be renewed at closer intervals. The result has been that fireboxes are being constructed with a special view to meet the requirements of the situation. Seams are being avoided as much as possible, and button headed crown bolts are dispensed with, radial stays being found more durable under such conditions, the latter being found less affected by heat, as well as insuring better circulation above the crown sheet.

Altogether the advantages of the use of oil fuel much more than overcome the disadvantages. Recent discoveries of coal deposits in the districts where oil burning locomotives are in use do not seem to affect the growing favor of the oil burning locomotive. Even if the coal were of the best, which it is not, and even if found more easily and in larger quantities, it is not at all likely the other advantages in the use of oil fuel will be overcome. That the supply of oil fuel is apparently as unlimited as the supply of coal is a question which only time can answer, it is nevertheless apparent that the universal use of oil fuel on locomotives in certain sections seems at hand, and will likely continue for an indefinite period of time.

Facts and Fancies.

While old-fashioned notions had not fallen out of date, people used to say that facts were stubborn things, hard to beat, but a leader of modern thought who has been lecturing at Columbia University, New York, on Spirituality and Liberty, said that the natural constitution of the human mind and its inability to understand free will induced men to pervert facts into arguments for determinism.

"Nothing is harder than to see a fact clearly without prejudice," he said, "for in our attempts to do so we are tempted to add to the fact a theory, which will make it more easily explicable to us. Scientific education should go far toward giving us an impartial view of fact were it not that science itself makes us see facts by the light of those theories which have been most conducive to success in its struggle to dominate inert matter. Such facts as do not fit into these theories it ignores or discards.

"This is peculiarly true of those facts which bear on the relation of body and mind. Of these facts it only emphasizes those which express mind as a mere product of cerebral action or as a counterpart in mental terms of what can be more definitely expressed by the physical condition of the brain. It is ever trying to reduce mental phenomena to physical terms."

Origin of Anti-Railway Sentiment.

The natural condition of every country is not conducive to easy means of transportation. The North American Continent at the time the United States became a nation was nearly all a wilderness of forests, brush and moorland with few villages and spots of cultivated lands. The prevailing practice was for the homeseekers and settlers to locate near navigable streams on which markets could be reached. Roads fit for carrying wheeled vehicles were few and far between. Almost the first combined movement of the new nation was working on schemes intended to provide substantial highways, but the move resulted only in a series of fragmentary beginnings that stopped at state lines or at expensive obstructions such as rivers and mountains.

When railway construction began there was an excellent field in the United States for that method of transportation and public opinion became enthusiastically in favor of railway extensions. In many cases states gave substantial aid to the promotion of railway enterprises and it became common for towns and districts to bond themselves to defray part of the expenses of railways on the condition that the lines should follow certain

specified routes. A conspicuous sentiment prevalent all over the Union was praising the good that railways were capable of doing and the desire to receive the benefit of railway transportation. Previous to 1870 a word of disparagement concerning railways was seldom heard and then only from districts that had been missed by the railroad builders. Railway lines had opened up vast regions to settlement and converted a far extending wilderness into fertile fields covered with happy homes.

Owing to the scarcity of roads in the United States, the advantages of railways were thoroughly appreciated from the first; but that was not the case with some of the older countries where statute roads extended far and wide. The British Isles favored railways more readily than other European countries, but many harassing obstructions were placed in the way of this new form of transportation. There were immense vested interests that opposed railway building and nearly every land owner tried to make a small fortune for granting right of way, and parliament seemed to aid the extortionists and promote the obstructionists. One means used to embarrass railways was the enactment of severe laws against smoke from the locomotives and members of parliament gravely asserted that the smoke and gases caused by locomotive engines would kill vegetation, ruin the health of animals, and convert parts of the country into a desert.

In the fairly settled portions of the United States the people gave railroads a warm welcome and stretches of track soon began to connect towns capable of supplying paying business. These pieces of track were afterwards joined together and formed the nucleus of through lines greatly to the benefit of the districts traversed. For many years good will prevailed between the railway companies and the public, both sides acknowledging mutual benefits.

But in course of time a different sentiment developed. While railways were under construction east of the Mississippi river, there was little complaint from the public of unfair usage from railroad managers, but when the era of speculative railroad building came to pass in the western states, a struggle for supremacy between railway managers and the public arose, which brought about the antagonisms that still prevail.

The first scenes of railway antagonisms were in what are now the States of Minnesota and Wisconsin. In 1856 Congress granted to the Territory of Minnesota large tracts of land to aid in building railways, which were at once paraled out by the legislators to four or five companies. Land was not easily converted into cash at that time, so railway building lagged and the Territory was induced to grant a loan of $5,000,000. Part of that sum was issued and a few miles of railway were graded, but the bonds were granted for finished lines, so it became necessary for the state to secure possession of the tracks by legal proceedings.

The people in these territories were so solicitous to secure the benefit of railroads that they permitted the railway constructor to have his own way and he became an autocrat with no regard for the people's interest. No form of exaction was too outrageous for him to adopt so long as it took possession of public property. Railway credit had fallen so low that the story is told of a subcontractor having claims for work done being offered $100,000 in railway bonds which he refused but expressed willingness to accept ten dollars in cash.

In his well known book on the Railway Problem, Mr. A. B. Stickney says:

"At the close of 1867 there were 482 miles of railways completed in Minnesota. Four original land-grants were well under way and to use a homely phrase they had 'gone through' the state and had appropriated every resource it possessed that could be made available for railway construction. They had secured from the legislature a contract forever exempting their lands from taxation, which was soon confirmed by the people by an amendment to the Constitution. They had invented the pernicious principle of allowing cities, towns and counties to issue bonds for the construction of railways. They had discovered that the power they possessed of varying the location of lines, their stations and their workshops was sufficient to extort money, right of way and lands from individuals and 'bring to their sense,' as it was termed, interests that opposed their exactions.

"The managing officers were now potentates—'railroad kings.' They traveled in state, surrounded by their personal staff. When they visited a town on their lines, the principal business men rushed to greet them. Merchants sent baskets of champagne to the heads of the traffic departments and sealskin jackets for their wives, while on the other hand special rates were liberally bestowed upon favorites.

"By the close of 1867, five railway companies controlled all the transportation business west of Chicago, and treated the public as if the people had no rights which the railway managers were bound to respect. They acted as if they owned the earth and the fullness thereof. About this time there commenced among the people a discussion of the principles which should govern the management and operation of railways and their relation to the people which a few years later culminated in the first of the 'Granger Laws.'

"Very loose charters had been granted by the states to the railways in the pioneer times and these claimed that the charter rights exempted them from control of the law as common carriers. The managers claimed the right to charge such rates for transporting both persons and property as they deemed for the best interests of their respective companies, regardless of their reasonableness or equality. They claimed and exercised the right to grant monopolies in business to favored individuals and firms—for example, one man or firm would be granted the exclusive privilege of buying all the wheat or corn or selling all the fuel, wood and coal; and by the exercise of their power to discriminate in regard to rates and accommodations, they were able to enforce these grants of exclusive privileges with a certainty never before experienced.

"They assumed the right to dictate to the communities in what market town they should sell their produce and buy their supplies. Thus, a community forty miles from St. Paul and four hundred miles from Chicago, was compelled to trade in Chicago, so as to give the railways the 'long haul.' To enforce this dictation the railway managers made the rates for forty miles haul greater than the rates for four hundred miles. Discrimination in favor of localities by means of rates was almost universal, but worse than that cruel discrimination was exercised between individuals so as to determine which merchant or manufacturer should be prosperous and which should fail in business. Taxation without representation is a light form of tyranny compared to the discriminating against a person's business as was practiced by the railroad magnates during the sixth and seventh decades of the nineteenth century. These men sowed the wind without scruple or principle and railway interests have been reaping the whirlwind ever since."

Professor Huxley on Industrial Education.

Professor Huxley, the celebrated scientist, could not be accused of undervaluing science, but he never lost sight of the fact that practical work kept the world moving. In addressing the students of a scientific school he once took occasion to urge the necessity for combining skill in handicraft with technical knowledge. All his life he had been trying to persuade people that, if they wanted to teach physical science, it was no use to proceed by filling the minds of the students with general propositions which they did not understand, from which they were to deduce details which they comprehended still less.

The learned professor spoke of the advances made in providing scientific education for artisans and anticipated that progress in this line was destined to become very rapid, all of which has become verified.

Air Brake Department

Frictional Resistance.

Air brake inspectors and repairmen should know, in a general way at least, what the pull of a brake shoe on a car wheel is based upon and in what manner this pull is obtained and we have attempted to simplify or recommend a simple rule to be followed in calculating car brake leverage, and anyone interested can readily recognize the principles involved and be enabled to make use of them when a practical application becomes necessary, and it is now desired to deal with some of the effects that result from applying a brake shoe to a revolving car wheel.

While some instructors may often appear to be dwelling at length upon an uninteresting subject, there are many things in connection with leverage and brake shoe friction that should be understood, especially as the usually accepted methods of determining the origin and limitations of the braking forces are anything but complex.

It is understood that the brake cylinder utilizes the power of the compressed air and transmits it to the brake shoes to become effective on the car wheel, and the shoe, coming in contact with the revolving car wheel, produces friction and in actual practice, when a shoe is drawn against the wheel of a moving car two different kinds of frictional resistance are in effect on the wheel. The friction between the shoe and the wheel is termed a dynamic or kinetic friction and can be taken to mean a friction resulting from one surface in contact moving upon the other.

Between the wheel and the rail there exists a static friction or what may be termed a standing friction which is the resistance to movement that is obtained between two objects when their surfaces are fixed in contact. This term static friction is derived from the fact that no matter how rapidly the wheel revolves it is always stationary in its relation to the rail, that is, some part of the wheel is always at rest on the rail regardless as to how fast the wheel is turning.

The dynamic friction between the shoe and wheel tends to check the rotation of the wheel, while the static friction between the wheel and rail tends to keep the wheel in motion, and if the former force exceeds the latter, wheel sliding will result and if the weight on wheel and length of slide is sufficient ruined wheels will be the result.

The dynamic friction is, however, a variable force, while the static friction referred to is practically constant for all speeds, but before going into any details concerning the amount of friction developed at any point, it is necessary to make use of two terms used by air brake men when discussing matters pertaining to the effects of friction, namely, the co-efficient of friction and the co-efficient of adhesion.

When the brake shoe is pressed against a revolving wheel with a certain degree of force expressed in pounds, the result is the creation of another force measured by the pull on the brake beam hanger, and this force, the actual pull of the shoe tending to stop the wheel, is the co-efficient of friction. Similarly it will require a certain force to draw a casting along on a sheet of metal or a metal floor and the force required to draw it is always a per cent. of the weight of the casting and is referred to as such or, should the weight of the casting be 400 lbs. and the weight necessary to draw it 50 lbs., the co-efficient of friction would be 12½ per cent., as 50 lbs. is 12½ per cent. of 400 lbs.

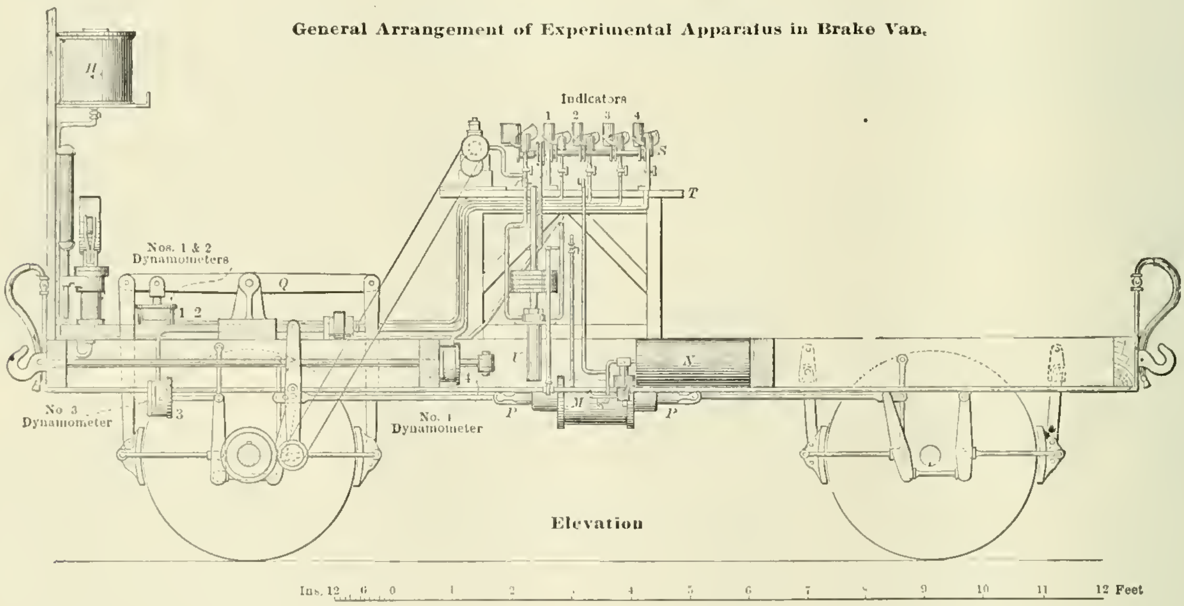
This amount of friction varies with the composition of the metals in contact, the tendency being for the softer metals to produce a higher co-efficient of friction than metals with a harder or chilled surface and it is understood that lubrication would reduce and tend to destroy the friction while the use of sand, emery or some similar substance would increase the friction above that resulting from the contact of the metals alone.

The co-efficient of friction of any class of brake shoe is determined by test, and devices known as brake shoe testing machines are used for this purpose. A car wheel is attached to a shaft and fly-wheel which are turned by a motor which can be disconnected when the wheel attains

Fig. 3

GALTON-WESTINGHOUSE TESTS.

General Arrangement of Experimental Apparatus in Brake Van.



the desired speed, the wheel is then stopped by an application of the brake shoe to be tested. Of course tests under different conditions can be conducted or the wheel can be kept in motion while the shoe is in contact and to note results a dynamometer is connected with the end of the shaft that holds the brake shoe in position on the wheel.

The brake shoe is pressed against the wheel with a predetermined force secured by means of weights that can be varied and the force in pounds registered by the dynamometer, divided by the weight in pounds pressing the shoe against the wheel is the co-efficient of friction. Everything else being equal the co-efficient of friction also varies with a change in the condition of the surfaces in contact, for instance, the friction resulting from a new brake shoe being applied to a new wheel is almost 50 per cent. less than that resulting when the shoe and wheel are pretty well worn.

The weight holding a car wheel to a rail is frequently termed the adhesion of the wheel to the rail, and with the wheel in motion there is a constant force or friction between the wheel and the rail which tends to keep the wheel revolving and this force, which is a per cent. of the weight holding the wheel to the rail, is the co-efficient of adhesion.

As previously stated this force is constant at all speeds, but varies with the condition of the rail. With a damp or greasy rail this co-efficient or factor of adhesion may be as low as 15 per cent. of the weight holding the wheel to the rail, or the use of sand on a dry rail may increase the adhesion to 35 or 40 per cent.

In actual service, the co-efficient of friction is of such a variable character that percentage of braking power based upon the weight of a car is no longer regarded as a basis to determine the amount of brake shoe pressure that can be employed without danger of injury to the wheels, so far as said injury is liable to occur during the brake application on any single car.

It also follows that if every car brake does its own share in stopping, all cars in the train will stop as one vehicle.

The brake shoe friction once having been established for any type of shoe varies from the instant the shoe is pressed against a car wheel for the purpose of stopping a moving car.

There is a loss in the co-efficient of friction with the increase in the speed of the wheel, with an increase in the load pressing the shoe against the wheel, and with an increase in the length of time the shoe is held against the wheel, and during brake shoe tests, friction increases with a decrease in the speed of the wheel. The decrease in the friction due to an increase in the speed of the wheel is but natural, as the faster the surfaces pass each other the less becomes the opportunity for the shoe to effectually grip the wheel, while at low speeds the abrasions or elevations and depressions on the face of the shoe and wheel tread tend to interlock, but at the high speeds the surfaces pass each other too rapidly to produce a very high degree of frictional resistance. The decrease due to an increase in the load or force pressing the shoe against the wheel can best be brought to attention by a statement that at a moderate brake shoe pressure the co-efficient of friction is greater than at a higher shoe pressure, or at a convenient rate of speed, a shoe pressed against the wheel with a load of 3,000 lbs. may produce a frictional effect equal to 25 per cent. of the weight, which if increased to 6,000 lbs., the frictional effect or the actual pull of the shoe on the wheel will fall to 20 per cent. or 21 per cent. of the weight forcing the shoe. It will be noted that while there is a greater retarding effect as the result of the 6,000 lbs. shoe pressure the co-efficient of friction does not attain the same proportional rate of increase as with the lower pressure, which is undoubtedly due, in a large measure, to the increase in the temperature that must result with an increase in the pressure.

Speed of the wheel and shoe pressure remaining constant, the frictional effect decreases with the increase in the length of time the shoe is held against the wheel, which is also due principally to temperature as the result of continued friction.

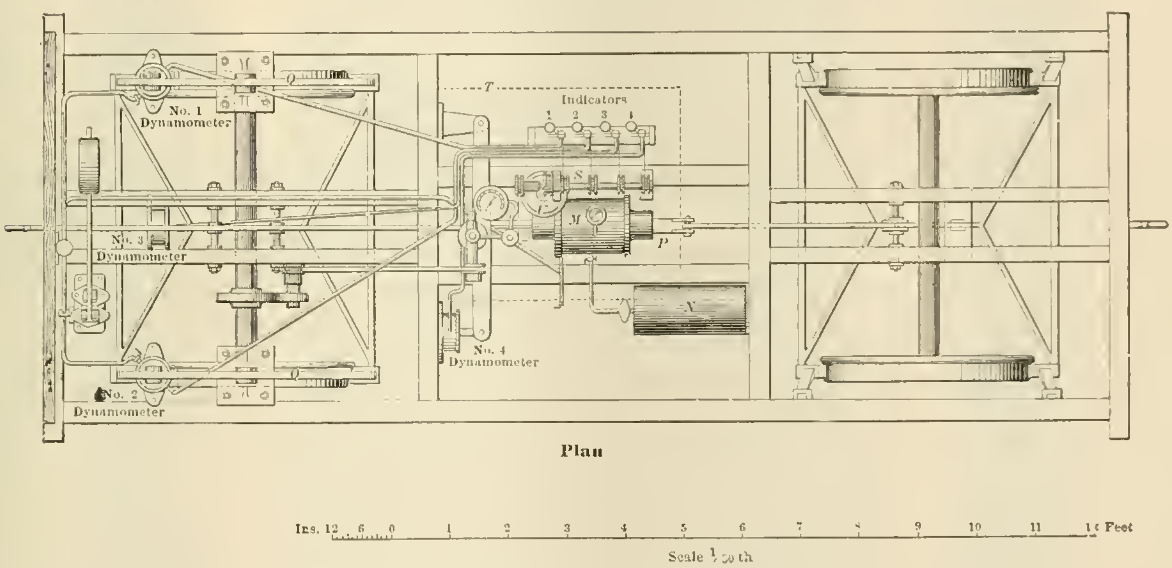
Ordinary methods of generating heat are very slow in comparison with a rise in temperature sufficient to burn particles of cast iron almost the instant the shoe touches the wheel and from a scientific point of view, the heat generated at the brake shoes while stopping a train of cars represents exactly the amount of energy that was stored in the train by the locomotive.

During stops with heavy cars from high speeds the increase in temperature due to higher shoe pressures necessary to stop heavier cars and the tendency of brake shoe metal to flow as a result of the intense degree of heat generated, and at times the warping of the shoes as a result of the same temperature combines with other effects in preventing any material increase in the co-efficient of friction due to a decrease in the speed of the wheel. This, however, is one of the many serious problems that are encountered in stopping trains from high speeds when modern heavy equipments are in use.

GALTON-WESTINGHOUSE TESTS.

General Arrangement of Experimental Apparatus in Brake Van.

Fig. 4



Plan

The heat we have referred to is dissipated by being forced through the brake shoe, by being absorbed by the wheel, and in heated particles of metal being thrown off the shoe and burned in contact with the atmosphere. All other things being equal, the shorter the space of time in which the wheel is brought to a stop the higher the degree of heat generated.

The retarding force of the brake shoe must be limited to the adhesion or resistance obtained between the wheel and the rail, and the greatest retarding effect is produced when the brake shoe friction amounts to a quantity just a trifle less than the adhesion, and if the frictional effect exceeds the adhesion the wheel will lock and slide. If the rotation of the wheel is arrested by the shoe before the train is stopped, the measure of retardation then arises from the friction obtained through the wheel sliding on the rail, and the amount of retardation obtained is found from the force exerted in holding the wheel in its fixed position or by the force requiring to draw the sliding wheel along on the rail. The friction between the wheel and the rail during wheel sliding is but a fraction of the amount obtained between the shoe and the wheel when the dynamic friction is produced at this point, and the pressure required to slide the wheel is much higher than that required to hold them sliding.

At a constant speed, the difference in draw-bar pull when the wheels are revolving freely and when the shoes are drawn against them may be taken to represent the brake shoe friction, but if the wheel picks up and slides the draw-bar pull will be considerably reduced. As an example, the co-efficient of dynamic friction between a steel tire and steel rail just at the time of coming to rest is approximately 25 per cent., but at 14 miles per hour it is but .072 and at 40 miles per hour .057.

In other words, the retarding force at the moment of sliding increases to an amount much beyond that which prevailed before the sliding took place, but immediately after complete sliding has taken place the retarding force falls much below the figure that was attained before sliding.

At this time it will be clear to the mind of the student that a frictional force capable of checking the rotation of a wheel at a speed of 10 miles per hour must be increased in order to slide a wheel at a speed of 20 miles per hour, and not only do the surfaces in contact pass each other more rapidly as the speed increases, but the increasing speed of the wheel continually adds to, and stores up, an energy that must be destroyed by the brake shoe during the stop.

To calculate the forces that are in effect upon revolving car wheels under the different conditions mentioned, involves but the simplest problems in arithmetic, and as a guide to the student that may be of a speculative turn of mind, we will print a few tables that will be of assistance; they are self-explanatory and are taken from the justly celebrated Westinghouse-Gallon tests, conducted in England in the year 1878 and they are to this day accepted as a reliable reference and authority.

The first table shows the co-efficient of brake shoe friction observed at various speeds, cast iron shoes on steel tires. All the results are the average of a large number of experiments.

Miles Per Hour.	Maximum.	Minimum.	Mean.
60	.123	.058	.074
55	.136	.060	.111
50	.153	.050	.116
45	.179	.083	.127
40	.194	.088	.140
35	.197	.087	.142
30	.196	.098	.164
25	.205	.108	.166
20	.240	.133	.192
15	.280	.131	.223
10	.281	.161	.242
7½	.325	.123	.244
Under 5 miles	.340	.156	.273
Just moving..	...	...	.330

The following table gives approximately the proportion which the pressure to be applied to the brake blocks should bear to the weight upon the braked wheels, with co-efficients of adhesion between wheel and rail varying from .30 per cent. to .15 per cent. of the weight on wheels.

Co-Efficient of Adhesion.

Speed in Miles Per Hour.	0.30	0.25	0.20	0.15
7½	1.20	1.04	0.83	0.60
15	1.41	1.18	0.94	0.70
20	1.64	1.37	1.09	0.82
30	1.83	1.53	1.22	0.92
40	2.07	1.73	1.38	1.04
50	2.48	2.07	1.65	1.24
60	4.14	3.47	2.77	2.08

It will be seen that when the adhesion equals .30 per cent. of the weight, a pressure equal to 1.2 per cent. of the weight would slide the wheel at 7½ miles per hour, while a pressure equal to 4.14 times the weight would be required to do so at 60 miles per hour.

The next table shows the difference in retarding effect obtained between the wheel and rail when sliding on the rail when compared with the first table.

Dynamic Friction Between Wheel and Rail.

Miles Per Hour.	Steel Tire on Steel Rail.	Steel Tire on Iron Rail.
Just coming to rest	.242	.247
6.8	.288	.095
13.6	.072	.073
27.3	.070	...
34.1	.065	.070
40.9	.057	...
54.5	.038	...
60.0	.027	...

The last table shows the co-efficient of friction as affected by time. The decrease in the friction being due to the increase in the length of time of application.

The figures showing the co-efficient of friction at the commencement of the experiment are slightly different from those given in the first table, as they resulted from the average of a fewer number of experiments, but the effect of time in reducing the friction may be taken as correct.

M. P. H.	Commencement of Experiment.	After 5 Seconds.	After 10 Seconds.	After 15 Seconds.
20	.182	.152	.133	.116
27	.171	.130	.119	.081
37	.152	.096	.083	.069
47	.132	.080	.070	...
60	.072	.063	.058	...

The experimental van, the general arrangement of which is shown in the cuts, was used on the London, Brighton & South Coast Railway in securing the data from which the tables were compiled, and the result is as nearly correct as it is possible to ascertain.

Frozen Distributing Valves.

The open season for frozen brake pipes and distributing valves, although somewhat later than usual, has again been with us, and may continue longer than usual, and should be guarded against.

Many engineers have had the effect of a frozen brake pipe indelibly impressed upon their minds by an actual experience and the effect of a partially or entirely frozen distributing valve, under modern operating conditions, is liable to be undesired quick action, a run past a stopping point, a broken train or loss of train control on a grade.

The surest way to prevent the freezing is to keep water out of the valve, and the only way to do it is to reduce the temperature of the compressed air to that of the surrounding atmosphere before it reaches the distributing valve. Briefly, this involves not only size, number of and location of main reservoirs, length and installation of piping, but the condition of the air compressor as well, and regardless as to frequency of main reservoir draining, moisture will collect in undesirable places in the brake equipment if the lowering of the temperature of the compression occurs in those localities.

Testimonial to Mr. W. V. Turner, Chief Engineer Westinghouse Air Brake Company.

For this issue we have secured a photographic reproduction of a testimonial voted to Mr. W. V. Turner, Chief Engineer of the Westinghouse Air Brake Company, by the members of the Air Brake Association during the 1912 convention at Richmond, Va.

The readers of our Air Brake Department know of Mr. Turner from his invention and development of the E. T. locomotive brake, type K and L triple valves, the P. C. equipment for passenger cars, the empty and load brake for freight cars and the electro-pneumatic brake for electric and steam road service.

Briefly, the testimonial is in recognition and appreciation of the time he has chosen to spend with the members during conventions and of his solutions of the many intricate problems that have from time to time confronted air brake men throughout the country.

Mr. Turner has long held an unique connection with the Air Brake Association in that any statement made by him is accepted, without question, as authority, which is a distinction that has never been accorded any other member.

Unquestionably the greatest of air brake experts and regarded by the Air Brake Association as the only perfect instructor, they have not been alone in recognizing in him a genius and a scientist, and foremost among the many other societies that have conferred honors upon him is the Franklin Institute of Philadelphia, one of the most scientific bodies of men in America.

As the outcome of a paper prepared and read by him before this institute, he was awarded the Edward Longstreet medal, and recently, in recognition of his development of air brakes for locomotives, cars and electric service and in consideration of over one hundred of his patents assigned to the Westinghouse company and as many more pending, he was awarded the Elliott-Cresson medal, which is the highest honor this body can confer upon any scientist.

The writer regards it as an honor to be fairly well acquainted with Mr. Turner and his methods.

He possesses a marvelous combination of inventive genius, literary ability, mechanical skill and fluency of speech, and one of his chief characteristics can well be emulated by our air brake readers, that is, absolutely no regard for hours spent on duty without ever an indication of weariness.

The names of George Westinghouse and Walter V. Turner will be known as long as the air brake is in existence, as the fruits of their persistence in the face of discouragements has already saved more lives than were ever lost in any war.

General Foremen's Department

Change of Address of Secretary of General Foremen's Association.

Mr. William Hall, secretary-treasurer of the International Railway General Foremen's Association, has removed from Escanaba, Mich., to 829 W. Broadway, Winona, Minn. Mr. Hall has obtained a transfer in the employ of the same railway company where he is employed, on account of the ill health of his family. Members of the association will kindly note the new address. Mr. Hall is already busy with the necessary arrangements in connection with the next convention of the General Foremen's Association which, as previously announced, will be held at the Sherman Hotel, Chicago, Ill., on July 15-18, 1913.

Expensive Cheap Help.

After a lull of a year or two, the industrial portions of the country have again been overtaken with a revival of scientific management sentiment and poor shop managers are getting pushed on to produce greater finished output without increase of expense. The writer is fairly intimate with conditions in European workshops and has found very little indication there of the "hurry up" sentiment, and it seems strange that the burden of that sentiment should be inflicted most heavily upon American mechanics who have always been famous for the quantity of work turned out.

The sentiment that aims to convert a workman into an automaton is a cousin germain of expression common among proprietors of machine making factories in the days that machine making was changing to machine manufacturing. They said that "cheap help is as good as any. One man is as good as another. Just as easy to do work right as to do it wrong. Nobody can help doing it right, only give him the right tools." That philosophy was circulated for a purpose, which was to induce skilled workmen to submit to a reduction of pay when the piece-work system was in full operation.

In one sewing machine factory which took the lead in changing from hand making to manufacturing a complete set of tools, jigs and formers was prepared and the proprietors got boasting—"Got everything fixed now, so that nothing can go wrong. Shall have all the work done by them as soon as we can decide about prices. With much care bestowed upon learning how much work could be produced in a given time with the new appliances the work was all "pieced out" at prices less by thirty to fifty per cent. than could be made by the best efforts of day work.

A fine start was made. Proprietors were gratified; workmen were pleased to earn better wages, most of them taking great interest in having their work come out just right. But presently a change happened. The proprietors thought that the workmen were making too much pay a thing that has happened in too many other establishments. Prices were reduced in spite of the remonstrances of the superintendent. Many of the men quit and their places were filled with green hands. The office people insisted that with the tools and system in use green hands could do nearly as well as experienced mechanics, and the gabble "one man's as good as another, etc.," was repeated over and over again.

The superintendent of the works tells more particulars of the story thus: "Not long after the reduction was made, the senior partner escorted some visitors through the works, having invited me to accompany them to explain the different processes. All went well until the assembling and setting up department was reached. Many times before had a similar tour been made with admiring visitors who had been told by the smiling proprietor that "with our appliances and methods, nothing can possibly come wrong," and the setting up department had been shown up with especial pride, as proof of the entire correctness of the statement. The attention of the visitors was called to the manner in which everything came together. "The shaft on which these three cams go, has the three pin holes drilled through it, so nearly central, and the holes through the hubs of the cams are so nearly correct, that there is nothing to do but to slip a cam on to its place and take one of these pins, which we have cut by the thousands and drive it in."

Horrors! Just at this point a man was discovered with a cam in its place on a shaft, and reaming out the pin hole to make it match, the hole when done needing a pin nearly one-third larger than the regular size, a supply of the larger pins showing that it was not the first time the reaming operation had been performed.

During the storm that ensued the proprietor was assured that cheap help is not as good as any even in drilling holes. That the very appliances which are supposed to insure perfect work must be used just right.

Investigation will prove that those manufacturers having work done by the piece, who have pursued a liberal policy with their help, keeping all hands in a satisfied frame of mind, speaking with pride of all mechanical matters connected with the business, not only of their own share in it and feeling that they have been paid for all work done, knowing that all improvements on methods or appliances have benefited them instead of being seized upon by the company as a pretext for a cut down—have been most successful financially, have furnished their customers the most satisfactory goods, price and quality considered; and not least have greatly benefited society by elevating to positions of competence, independence and even wealth, many of their employees.

The other side shows employers whose every thought is how to make the most out of their help without thought of justice or fair dealing. There are exceptions, but the rule is that the grasping, unscrupulous employer eventually goes to the wall.

Filing.

Since the expenditure of energy by the workman is measured by his consumption of oxygen, Marey's graphical methods enable us to determine the muscular effort, the useful work, and the corresponding expenditure of energy. It is then only necessary to change each element of the work; its speed, its total duration, the attitude of the workman, and the form and dimensions of the tool, in order to find the best working conditions. The number of "variables" is generally very great. Some are mechanical, others physiological. The file employed was of medium hardness, and the length of stroke varied from 10 in. to 13 in. The material worked was brass. The workman was provided with a respiration-valve, for measuring the oxygen consumed. The chief conclusions arrived at are as follows:

1. The weight of filings taken off is generally proportional to the mechanical work, which equals the product of the length of stroke into the horizontal component of the muscular effort.

2. The rhythm of the stroke affects the quantity of work done. It varies in different individuals, but it increases the work performed up to 79 strokes per minute (about the frequency of the pulse).

3. The expenditure of work per weight of filings is less for frequent strokes than for a slow rhythm. Seventy strokes per minute is about the best.

4. The attitude of the body, whether straight or bent, its oscillations, its distance from the vice, the inclination of the arms, the inequality of their action, and the position of the feet, modify the expenditure of energy.

5. The conditions of highest efficiency are: Body straight, but not stiff, 8 in. from the vice, which must be at the level of the navel. Angle between the feet, 68 deg., with a distance of 10 in. between the heels (in the adult). Left arm fully extended, and pressing on the tool a little more than the right, the pressures being about 16 lbs. and 17 lbs. respectively. Return stroke an easy glide, and a rhythm of 70 strokes per minute. After five minutes of work, one minute of complete rest, arms hanging straight down. In practice, fitters are employed 8½ hours per day, of which 7 hours are effective work. This comes to 470,000 ft. lbs. of work per day, and should yield 1 lb. 3 oz. of brass filings.

This improved method increases the output of apprentices some 66 per cent. Fatigue is greatly reduced; respiration and pulsation undergo only half the usual increase; there is no pain in the forearm; and all irregular muscular action is done away with.

The graphic records of the work of different operatives give valuable indications concerning the differences due to age, experience, and physical condition.

Hardening Twist Drills and Taps.

There are a variety of methods of hardening twist drills and taps but the following has been found to be very effective: The prepared drills or taps are held with their spiral or screwed parts submerged in molten lead (brought to red heat in iron or earthenware crucibles) till they too reach red heat. For pieces 3/16 in. to ⅜ in. in diameter this takes about one minute. The pieces are then withdrawn and at once plunged into water. If the lead bath is at the correct temperature, no lead will cling to the taps or drills on removing them. After chilling, the latter are cleaned and tempered.

A convenient method of tempering is to lay the drills and taps in lots of ten or twelve on a sheet of iron mounted over a charcoal fire. The plate should be rocked during the process in order that the pieces may be quite uniformly heated. On reaching a dark gold temper film, the articles are again water-quenched, and are then ready for use. The advantage of carrying out the first heating in lead instead of by direct firing is that the degree of heating is strictly limited, and it is impossible to burn the edges of the threads and drill grooves while waiting for the core to heat. Further, by the above process only the working parts are hardened, and the heads of the taps or drills can be subsequently worked if necessary.

Ancient Tools.

Metal tools and implements have performed such important functions in the development of civilization, that nearly every one interested in history finds pleasure in following the growth of metallurgy. Without the use of metals there could be no tools except those of the crudest character, and without good tools there could be none of the comforts, refinements and luxuries that make people civilized.

For years there has been difference of opinions among antiquarians about what metal was first in the service of mankind. Investigators of the subject have taken two sides. One party contends that bronze was the first metal used for tools, implements and weapons and they furnish many archaeological discoveries sustaining their belief. The other side believes that iron was the first metal worked to any considerable extent, and their claims seem to be substantiated by convincing evidence from history, philology and various other sources.

Considerable study of the subject has led us to believe that iron was first used for tools in India and other parts of the Orient, while bronze was used in regions where copper and tin could be procured. Peruvians used copper weapons which tradition says were capable of taking a hardened edge, but this belief has been contradicted by recent experiments with the weapons.

Discoveries that were made in some drained Swiss lakes threw much light upon the weapons and implements used by lake dwellers for hundreds of generations. The periods investigated extended from the Stone Age to comparatively recent times. The implements and domestic utensils of the Stone Age were exceedingly crude, but they went on improving till in the bronze age considerable artistic skill had been attained. The people lived in houses on the lakes sustained by piles for protection from the marauding land tribes. They seemed to be as well provided with utensils and weapons as the people living on land.

Liquid Fuels.

Professor Lewis, of the Royal Society of Arts, London, England, speaking on "Liquid Fuels," said that in the near distant future they would be brought face to face with the problem, what fuel to adopt, and when they reached that point, then they would find there was only one illimitable fuel, and that came from the sun's energy. There was only one way to quickly regenerate the sun's energy to make it available for power, and that one way was alcohol. In vegetation they would find the energy absorbed by the plant from the sun through those wonderful chemical processes which built them up into the wood of the plant—that energy could never be again regenerated as coal or oil, but into alcohol. There they had the only method by which that quick regeneration could be brought about; but at present alcohol was practically out of the question.

Proceeding, the professor said that in the last twenty-five years petroleum products had entirely revolutionized vehicular traffic in all parts of the world. There was, however, not the slightest doubt that there were plenty of straws that indicated that the supply of petroleum was not the illimitable supply fondly imagined some time ago. The day would come when the supply would give out; but it was not yet. Although petroleum was far and away the chief liquid fuel, they must not lose sight of other liquid fuels. In the little strip of land on Lord Dalmeny's estate on the Firth of Forth they would find the shale deposits on the Lothians, which, distilled, would yield a certain amount of oil such as they yielded before Drake had struck oil in Pennsylvania. There were also deposits in Dorset, which had never been used because they contained so much sulphur as to be practically unusable, but that, some day, would be pressed into service. Also from the tar they got oil which, properly distilled, was useful for some purposes, and could be used for naval work.

Life of a Rail.

The life of a rail varies, and depends on the amount of wear it gets, both by speed and weight; the composition of the steel, whether curved or straight, also its situation. There is also a greater amount of wear on a rail laid on a gradient than one laid on a level road. You can say the present main-line rail lasts from five to twenty years. If you examine a rail, you will find it is really a long, thin girder. The flanges not only strengthen the rail, but distribute the load, and consequently wear, over a larger surface.

Iron or Steel.

Workshop tests consist of letting the bar or piece fall on the ground and listening. A little practice with known pieces will make you quite expert. If trying on the emery wheel, the kind of sparks emitted by the piece is a good indication of the kind and quality of the metal. Here, again, practice with known pieces is necessary. Acid tests are only used in the laboratory.

Electrical Department

Gas-Electric Motor Cars on Chicago, Milwaukee & Puget Sound Railway.

Two gas-electric motor cars are operating on branch lines of the above railroad in the State of Washington. One of these cars operates between terminal points of 14 miles distance, making five single trips per day: the other car makes one round trip from Seattle to Enumclaw, covering 124 miles daily.

The cars are of the combination passenger, 70 ft. 5 in. long and 10 ft. 5 in. wide, weighing approximately 50 tons and having a total seating capacity for seventy-seven people.

The principle of operation is as follows: An eight cylinder, four cycle gas engine, is direct connected to an electric generator, and drives same at practically constant speed for all speeds of the car. Two electric railway motors of 100 h. p. each are mounted on the forward truck. Electric current is supplied by the generator to the motors through special controllers. An arrangement is provided so that the fields of the generator are varied and thus a varying voltage from zero to maximum is obtained, so that the resultant speed changes of the motors produces a smooth and rapid acceleration without loss in resistance or gear changes.

It is interesting to note that these cars which were built by General Electric Co. made the long trip across the continent under their own power, averaging 220 miles a day; daylight running, with a maximum days running of 315 miles.

More Gas-Electric Cars.

The Great Northern Ry. Co., St. Paul, Minn., recently ordered from the General Electric Co., two gas-electric motor cars. These will be of the large 70-foot type, as described above, and will be placed in service on the branch line of the Great Northern system running between Rockport and Anacortes, Wash.

The Minneapolis, St. Paul, Rochester & Dubuque Traction Co., Minneapolis, Minn., will place in service on its line two more gas-electric cars of the 70-foot type. A gas-electric locomotive has also been ordered.

Electrification of the Melbourne Suburban System of the Victorian Railways.

Probably the most notable railway electrification project at the present time is that about to be undertaken in connection with the suburban steam railways of Melbourne, Australia.

Melbourne, the capital of the State of Victoria, is situated in the southern part of eastern Australia on the Yarra River, eight miles from its mouth at the head of Port Philip. The river is accessible for vessels drawing 22 feet of water, and all larger vessels are easily accommodated at Port Melbourne in Hobson Bay. Along the river are large docks, shipyards, foundries and manufacturing plants representing a number of industries. The city has a population including its suburbs of over half a million, and is the most important municipality and the greatest trade emporium in Australia.

The electrification of the Melbourne Suburban Railways is of exceptional interest because it will be one of the largest projects of its kind in the world, involving heavy rolling stock equipment with overhead collectors. The magnitude of the undertaking from the standpoint of equipment and service may be compared with that on the third rail electrified section of the New York Central Railroad out of New York City, and ranks with the Oakland, Alameda & Berkeley electrification of the Southern Pacific Railroad at San Francisco.

Naturally, the great size and tremendous importance of the project attracted world-wide competition. The contract for the rolling equipment was awarded the General Electric Company and 400 motor car equipments, and 400 trailer cars, will be required.

The mileage of the suburban lines is made up of 150 route-miles, or 289 track-miles of running road, and 34 miles of sidings. The track will be electrified with 1,500 volts direct current, with overhead wires. Power will be supplied in the form of three phase alternating current at 25 cycles per second and will be transmitted at 20,000 volts to twelve substations at various points on the system, where it will be converted into the operating direct current of 1,500 volts. The high tension transmission is by underground cables from the power house to the important substations in the central area, and by overhead wires erected on the same structures which carry the railway track conductors , to the outlying substations. Overhead conductors will be used throughout the system for supplying current to the trains, which will be equipped with roller pantograph collectors. The complete equipment of the railways involves the expenditure of $12,000,000 in round numbers, and it is estimated the saving of electric operation will amount to about $600,000 in 1915 over the former steam operated lines.

Normal trains, weighing about 180 tons, will consist of two motor coaches and two trailer coaches. The tracks are 5 ft., 3 in. gauge. The suburban traffic amounted to 70,000,000 passengers in 1908; the figure the past year exceeds 90,000,000; and in 1917, when it is expected that the conversion to electric operation will be entirely completed, it is estimated that the suburban lines will carry 150,000,000 passengers per annum.

GAS-ELECTRIC MOTOR CAR FOR THE CHICAGO, MILWAUKEE & PUGET SOUND RAILWAY.

The present plans are accordingly based on provision for this probable increase in the passenger traffic; but all parts of the electrification scheme are arranged so as to be capable of extension from time to time, as the traffic subsequently grows. Handling heavy traffic during the rush hours of morning and evening will be provided for by increasing the length of trains, although for this initial service it is the intention to have the maximum train consist of six coaches.

The motors, numbering 1,600 in all, which will be installed in the 400 motor coaches, will be of new design throughout and will embody the most modern developments that the General Electric Company has introduced in railway motor construction. They will be known as Type GE-237, will have inherent ventilation and be provided with commutating poles. They will be rated 140 horsepower at 725 volts and will be operated two in series on 1,500 volts.

Electrification of steam roads both here and abroad has emphasized the fact that the conversion to electrical operation is always accompanied by a faster and more frequent train service, and because of greater convenience, comfort and cleanliness, a general improvement in suburban traveling conditions, while the reduction in working cost and the increased earnings of the line combine to produce larger profits.

Hardening Steel tools by Electricity.

Electricity at the present time is being used for all sorts of work processes, etc., to great advantage, one of the recent uses to which this power has been put is the hardening of tool steel. Any improvement that can be obtained along this line will be appreciated by all who have anything to do with tools which must be properly hardened in order to get out the necessary work.

The process of hardening requires the maintenance of uniform temperature in the furnace to obtain the best possible results. This requirement is not fulfilled by the ordinary coal, gas or oil furnaces, nor even by the externally heated lead or salt baths. Any of the above arrangements are apt to cause local overheating, so that the sharp points of the tool will be heated to a higher temperature. Oxidation is also apt to occur, which interferes with the best possible work.

The greatest disadvantage of the lead bath is that the sudden heating of the tool will cause internal stresses, resulting in cracks. With the lead bath the tool will float on the surface, due to the difference in specific weight, and the dross which forms on the lead surface will interfere greatly. Moreover, the lead sticking to the tool, and the formation of poisonous gases, together with the above disadvantages and the fact that uniform results cannot be obtained, brings out the need for a better arrangement for the hardening of tools.

The electric furnace allows hardening to be carried out on scientific lines, for by this method it is possible to get *uniform* temperature and any uniform temperature over a wide range can be obtained. The electric furnace makes use of metallic salts, which are melted by the passage of an electric current through it and which is kept at a constant desired temperature, depending on the amount of current passing through when in the liquid form. The temperature is thus exactly controlled and the tool, when immersed, will be brought, evenly, to the exact temperature of the bath.

For hardening carbon steel requiring temperatures from 750 to 1,000 degs. C. (1,382 to 1,832 degs. F.), the bath should consist of a mixture of barium chloride ($BaCl_2$) and potassium chloride (KCl), the correct proportion depending upon the temperature desired. For ordinary tool steel equal parts by weight of these salts should be used. The higher the temperature desired the greater should be the proportion of barium chloride.

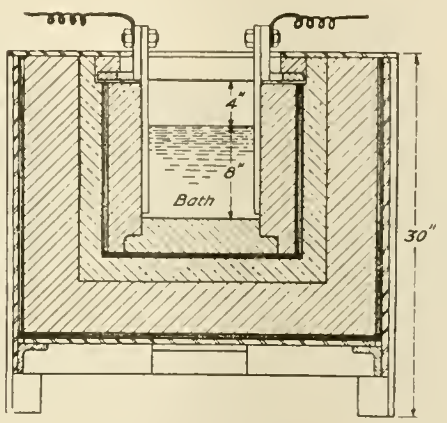


FIG. 1. SECTION OF ELECTRIC FURNACE.

For hardening high speed steel when temperatures up to 1,300 degs. C. (2,372 degs. F.) are required only barium chloride should be used. Only salts of the highest purity should be used, so as to eliminate any impurities which would attack the steel causing pitting.

An electric hardening furnace is built by the General Electric Company which we will describe. The elevator section is shown by Fig. 1. The furnace is built up of refractory and heat insulating material surrounded by a sheet iron case. The lining of the crucible consists of large, special fire brick slabs, joined and cemented together to prevent leakage of the bath. Two iron plates, one at either side, serve as the terminals and the electric current flows from one to the other through the bath. These iron plates will deteriorate and will have to be replaced, the frequency depending on the temperatures. A hood, provided with a warming oven, is placed over same and the gases should be piped away. These gases are given off in considerable amounts when the bath is cold and the electric current is first turned on, but very little is given off when bath is thoroughly heated.

Alternating current, preferably 60 cycles, must be used, and a transformer should be provided to step down the voltage of the sharp mains, which is probably about 220 volts to only a few volts at large current capacity. A regulating device should be installed so as to give a large variation in current values to obtain whatever temperature is necessary, as mentioned above..

The salts used for the bath are non-conductors of electric current when cold and it is necessary to cut a channel, leaving the chips in same, from one plate to the other, and heating up these chips by an auxiliary terminal when the current will follow across the melted portion, reducing the whole to liquid state.

When the desired temperature is obtained, as can be told by the use of pyrometer, the tool can be immersed in the bath and should remain there until of the same color. When the tool is removed, for immersion in the cooling liquid, enough of the bath adheres to the steel, in the form of crystals, to prevent oxidation, which chips off as soon as the tool enters the cooling liquid.

To sum up, the advantages to be derived from a hardening furnace of the electric type are that uniform temperature for hardening of any class of steel can be obtained; that equal and even heating prevents internal strains of the metal and the burning off of sharp points and edges; that oxidation, due to the air striking the hot steel, is avoided; that the exact knowledge of the temperature by means of a pyrometer is known. Moreover, this type of furnace is clean, safe, easy to operate and has a low cost for maintenance.

Study and Work

Study and work should go on together: careless reading or reading without concentration is of no value. The best method of acquiring knowledge of machine shop work is to combine a reasonable amount of persistence with care in selecting parts of the subject that are the most interesting each day. If the work of the day has brought out some perplexing problem regarding the adjustment of some part read up about that part and give it full study. Do not try to digest such things when there is no immediate prospect of their being required.

Elimination of Smoke.

Mr. D. R. McBain, superintendent of motive power of the Lake Shore, presented an interesting paper on the subject of the elimination of black smoke from engines recently before the International Association for the Prevention of Smoke, from which we quote the following:

The first efforts in the direction of smoke elimination in this country, that I can now recall, involved the careful instruction of firemen, but with the aid of no mechanical appliance save that of the blower. In effect, the instruction referred to was to maintain a good, clean, live, solid fire, and to feed not more than one shovelfull of coal at each firing—two at the most—keeping each shovelful as far apart as possible at all times, so that the gases distilled from the green coal would come in contact with a bright fire of very high temperature and be duly consumed. The instruction also pointed out that, if too light a fire were maintained, too much cold air would be admitted through the grates, and would cause the temperature of the firebox to fall too low to effectively consume the freshly distilled gases.

As a result of conscientious, expert effort on the part of the firemen, especially in the New York and Chicago districts where I was familiar with the conditions, some splendid work was done, and I have seen heavy freight and passenger trains taken from the starting point to beyond the limits—as much as 15 miles—without a jet of black smoke being emitted.

In so far as we could obtain the services of skilled and intelligent firemen, the results were fairly satisfactory, but inasmuch as the number of men possessing those qualities was insufficient to meet the demands, it naturally devolved upon the inventive mind to produce something that would mechanically supply that which was lacking in skill, in order to effect a more satisfactory solution of the smoke problem.

Without attempting to place them in the order of their importance, the things that are necessary, from my viewpoint, to successfully avoid the emission of smoke on hand-fired terminal power—that in which the public is mostly concerned—are:

First—A boiler and firebox in as nearly perfect condition as possible.

Second—Careful, intelligent and vigilant effort on the part of the engine crew.

Third—Proper care of boiler appurtenances.

Fourth—A good blower of sufficient size.

Fifth—The time-honored steam jet arrangement for the induction of sufficient quantities of air over the top of the fire, when needed.

Sixth—A suitably designed brick arch, properly installed and maintained.

Seventh—Good drafting of the locomotive so that forcing of the fire will be unnecessary.

Eighth—A well-proportioned superheater.

Ninth—The proper cleaning of smoke emitted from engines being fired up at engine houses.

The utilization of any one of the above will accomplish something in the way of smoke elimination—the condition for which we are striving—but the use of all of them combined will result in work very close to the 100 per cent. perfect mark at all times, even with the use of the most highly volatile fuels.

Treatment of Steel at Altoona.

At a recent meeting of the Pittsburgh Railway Club Mr. A. F. Mitchell read an interesting and instructive paper on Heat Treatment of Chrome Vanadium Steel. In discussing that paper Mr. Gustave Paterson said: "I was employed by the Pennsylvania Railroad in their testing laboratory at Altoona and for the last four years of my employment there spent my entire time in developing of heat treatment of various grades of steels, especially spring steel, and I do not believe there is any shop east of Pittsburgh that has gone so far in development of heat treatment of steels, nor has any one taken such good care of, or getting the best out of their material as they do there at present. Today they have not only a large force in the testing laboratory, but also an organization built up in the shops to take care of heat treatment of steels.

"What really started the P. R. R. in the heat treatment operations was the continuous trouble they had with locomotive springs. The amount of repairs to driving springs made at Altoona went into the thousands of pounds daily, and it was realized that something had to be done to stop the breakage of springs. The railroad officials sent me out to the various spring manufacturing plants to follow up their practice and see if we could learn something. I found that in most of the plants the steel was heated to any temperature, formed into spring leaves and then quenched in oil. They were not at all particular as to the temperature for quenching, which might be white heat or a low red heat at one end and black at the other. The consequence was they got springs of all kinds, as far as treatment was concerned. One leaf might come through the process all right, the next one might be too soft, and the third one might be brittle, which condition, of course, must influence the working of the spring; the brittle leaf would break, the soft one would set, and the spring was ready to go to the repair shop.

"When I returned to Altoona, we made a number of experiments until we found the proper treatment for the steel. We then designed a furnace in which we could obtain uniform heat, and started to heat treat our steel springs by scientific methods. A year ago when I left about 800 driving wheel springs had been sent out. They had been all marked and carefully watched. There had then been only two failures, and both of these on examination were found to be due to defect in the steel produced by overheating in the first treatment at the manufacturers works. All these experiments were done on repairing of springs, as the P. R. R. does not make new springs to any extent.

"I understand that the success they have had with spring steel under scientific treatment has led them to adopt heat treatment for a variety of other purposes, such as axles, crank pins, side rods, etc."

Latest Engine Freak.

There appears to be something alluring in the making of the very smallest machine of its kind ever put together. The competition in making the smallest steam engine has been very keen, but the limit seems to have been reached, and Tiny Tim, weighing just four grains complete, is the latest freak. It is made of gold and steel, and so small that a housefly seems large in comparison, such is "Tiny Tim," the smallest engine in the world. It takes over 100 such engines to weigh one ounce, almost 2,000 to weigh a pound, and more than 3,000,000 to weigh a ton. The engine-bed and stand are of gold. The shaft runs in hardened and ground steel bearings inserted in the gold bed. These bearings are counter-bored from the inside to form a self-oiling bearing. The flywheel has a steel center and arms, with a gold rim, and the complete wheel weighs one grain. The cylinder is of steel, with octagonal base, highly polished.

The stroke is 1-32 of an inch, bore 3-100 of an inch. Seventeen pieces are used in the construction of the engine. The speed of the engine is 6,000 revolutions per minute. When running 100 per second no motion is visible to the eye, but it makes a noise like the noise of a mosquito. The horsepower is 1-489,000 of one horsepower. Compressed air is used to run it, and it may be of interest to note that the amount required to make it hum can be borne on the eyeball without winking.

"Pitchforking" is the word used in New South Wales to express that form of transformation of energy which sends a railway man upwards ahead of his turn.

Six-Wheel Switchers for the Illinois Central Railroad

According to the latest report of the Interstate Commerce Commission, one out of every seven locomotives in the United States is a switching locomotive. On account of the frequent stopping which allows the cooling of cylinders, this type of locomotive is very inefficient.

The Illinois Central officials, in producing the design herewith illustrated, have adopted several features which should materially improve the efficiency of this type of locomotive. Ten have just been completed by the American Locomotive Company and thirty more are now under construction.

The main features of this design is the installation of a 19 unit, Schmidt type superheater in combination with the Gaines firebrick arrangement. There are many advantages commending the superheater switch engine. Not only is there a saving in fuel, but a large saving in water is obtained. Water is cheap, but the numerous trips the locomotive makes, leaving the yard to go after water, are costly. The saving in water should decrease the number of these trips, thereby increasing the actual working time of the locomotive. Because of the entire elimination of condensation with the superheater, railroad companies are not subjected to the annoyance and expense of damage claims for clothing soiled by the ejection of sooty water from the stacks of switching engines working in passenger terminals.

The Gaines arrangement of firebrick not only allows better combustion, but the back end of the firebox is more fully utilized, with a resulting increase in the generation of steam. With this arch the firebox measures 109⅝ inches long and 78 inches wide. A combustion chamber 38 inches long is formed, which leaves a grate area of 38.8 square feet with a firebox heating surface of 150.5 square feet. This increased firebox volume is one of the most important features peculiar to this arch. The amount of smoke should be greatly reduced. In large cities where smoke ordinances are strictly enforced, this feature is of much importance.

Advantage was taken of the outside steam pipes, Ragonnet reverse gear, Walschaert valve gear, and the builder's latest design of valve stem guide. Details of the design received the usual painstaking attention and follow in general the standards of the builder.

The following list of dimensions might be interesting:

Weight total, running order, 166,000 lbs.

Wheel Base—11 ft., 8 ins.

Tractive Power—32,450 lbs.

Valve Gear—Walschaert.

Cylinders—Diameter and stroke, 21 ins x 26 ins.

Driving Wheels—Diameter outside, 51 ins.; journals, 9 ins. x 12 ins.

Boiler—Type, Ex. wagon top; outside diameter of first ring, 63 ins.; largest course, 69½ ins.; working pressure, 170.

Firebox—Length, 109⅝ ins.; width, 78 ins.

Tubes—Number and diameter, 151-2 ins., 19-5½ ins.; length, 13 ft., 4 ins.

Heating Surface—Tubes, 1,046.8 sq. ft.; flues, 362.2 sq. ft.; firebox, 150.5 sq. ft.; total, 1,559.5 sq. ft.

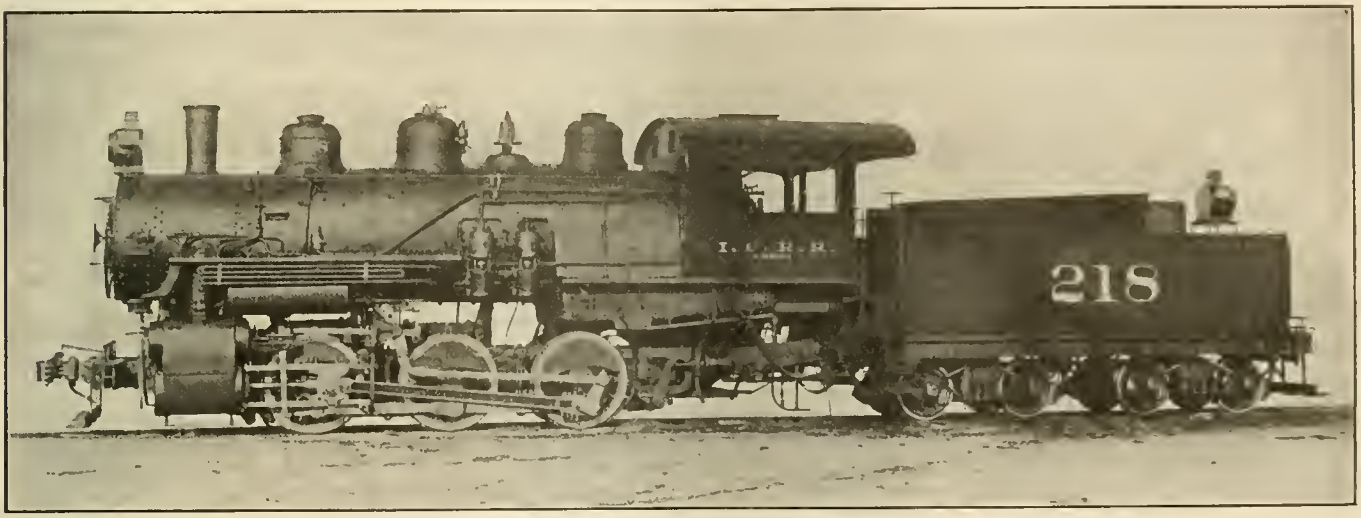
Superheating Surface—266.5 sq. ft.

Grate Surface—38.8 sq. ft.

Tender Capacity—Gals, 5,500; tons, 6½.

Length over all, engine and tender, 59 ft., 2⅛ ins.

Extreme width, 10 ft.; height, 14 ft., 7½ ins.



SIX-WHEEL SWITCHING LOCOMOTIVES FOR THE ILLINOIS CENTRAL RAILROAD.
M. K. Barnum, General Supt. of Motive Power. American Locomotive Company, Builders.

Trades and Callings.

It is interesting to observe the width of meaning that may be attached to common expressions which ordinarily are passed over without attracting special notice. We speak of a certain man as working at his trade, of another pursuing his calling. Now why should not every man who works at a trade be in the best sense pursuing his calling? If a man is engaged in the work pertaining to a certain trade, because he stumbled into it by accident when a boy, and cares nothing about excelling in it, that man may, perhaps, truly be said to be working at the trade of machinist, blacksmith or what not. The man, however, who was impelled to enter on mechanical work when a boy, less from the force of circumstances than because of a strong natural inclination, may be truly described as following a "calling" which brought him to that particular pursuit, and it may be truly said that the chances of such a man for success are very great.

Whoever does a man's work is doing God's work, and any calling which is pursued for the love of it, to the accomplishment of results useful to mankind, is entitled to man's highest respect.

Bronzing the Surface of Iron or Steel.

To give a bronze-like surface to iron or steel, thereby preventing rust: The object to be acted upon must be cleaned to take off oxidation or other impurities. It is then exposed for two or three minutes to the action of the vapors from a heated mixture of hydrochloric acid and nitric acid in equal portions at a temperature ranging from 550 to 650 degrees Fahr. After the objects have cooled they are to be rubbed over with vaseline and again heated until the vaseline begins to decompose. The treatment with the vaseline has to be repeated once. Should a lighter coloring than bronze be desired, mix the strong acids with acetic acid.

Items of Personal Interest

Mr. C. Perry has been appointed shop foreman of the Canadian Pacific at Brandon, Man.

Mr. A. H. Little has been appointed general foreman of the Seaboard Air Line at Raleigh, N. C.

Mr. A. L. Monroe has been appointed general foreman of the Seaboard Air Line, at Monroe, N. C.

Mr. J. Douval has been appointed instructor of apprentices on the Southern Pacific at Houston, Tex.

Mr. W. R. O'Neill has been appointed master mechanic of the Fayette Valley, with office at Fayette, Idaho.

Mr. E. S. Sheppard has been appointed machine shop foreman of the Baltimore & Ohio at Philadelphia, Pa.

Mr. James Ashworth has been appointed master mechanic of the Louisville & Nashville, with office at Boyles, Ala.

Mr. W. A. Cary has been appointed master mechanic of the Live Oak, Perry & Gulf, with office at Live Oak, Fla.

Mr. George W. Stubbs has been appointed master mechanic of the Ocilla Southern, with office at Ocilla, Ga.

Mr. A. S. Touhy has been appointed master mechanic of the Colorado & Wyoming, with office at Segundo, Colo.

Mr. W. B. Chenoweth has been appointed erecting shop foreman of the Trinity & Brazos Valley at Teague, Texas.

Mr. A. G. Walther has been appointed piece work inspector of the Baltimore & Ohio at the Mount Clare shops, Baltimore, Md.

Mr. J. W. Records has been appointed master mechanic of the Santa Fe, at Amarillo, Texas. He succeeds Mr. C. J. Drury.

Mr. C. E. Pharris has been appointed foreman of machine shops of the Southern, at Columbus. He succeeds Mr. J M. Plant.

Mr. M. C. Moore has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific, with office at El Dorado, Ark.

Mr. R. C. Cross has been appointed locomotive foreman of the Chicago Great Western, at Mankato, Minn. He succeeds Mr. R. Lawk.

Mr. J. B. Dougherty has been appointed master mechanic of the Baltimore & Ohio, at Benwood, W. Va. He succeeds Mr. T. F. Dreyfus.

Mr. Joseph A. Gilman, roundhouse foreman of the Santa Fe at Wellington, Kan., has been transferred to San Bernardino, Cal.

Mr. G. D. Siemental has been appointed master mechanic of the St. Louis, Rocky Mountain & Pacific, with office at Cimarron, N. M.

Mr. W. N. Green has been appointed assistant master mechanic of the Louisville & Nashville at the Boyles shops, Birmingham, Ala.

Mr. J. C. Furman has been appointed master mechanic of the Pennsylvania Southern, at Clarion, Pa. He succeeds Mr. J. W. Evans.

Mr. J. H. Farmer has been appointed locomotive foreman of the Chicago, Great Western, at Conception, Mo. He succeeds Mr. J. Forrest.

Mr. Albert E. Gowenlock has been appointed locomotive foreman of the Great Northern at Casselton, N. D., in place of Mr. J. T. Murtinger.

Mr. J. C. Love has been appointed road foreman of engines of the Los Angeles division of the Santa Fe, with office at San Bernardino, Cal.

Mr. R. O. Prendergast has been appointed master mechanic of the Cincinnati, Hamilton & Dayton, with headquarters at Indianapolis, Ind.

Mr. J. H. Schroeder has been appointed master mechanic of the Jonesboro, Lake City & Eastern, at Jonesboro, Ark. He succeeds Mr. R. W. Owens.

Mr. R. C. Hyde has been appointed master mechanic of the Louisiana division of the Chicago, Rock Island & Pacific, with office at El Dorado, Ark.

Mr. George Novinger has been appointed road foreman of engines of the Chicago division of the Baltimore & Ohio, with office at Chicago, Ill.

Mr. M. D. Stewart has been appointed master mechanic of the Houston Belt & Terminal, with office at Houston, Texas. He succeeds Mr. R. Fitzimmons.

Mr. A. A. McGregor, formerly master mechanic of the Louisville & Nashville, at Howell, Ind., has been transferred to the Boyles shops, Birmingham, Ala.

Mr. J. McCurdie has been appointed master mechanic of the Pascagoula-Moss Point Northern, with office at Moss Point, Miss. He succeeds Mr. H. Sylvis.

Mr. W. R. Earl, formerly machine shop foreman of the Baltimore & Ohio at Philadelphia, Pa., has been transferred to a similar position at Cumberland, Pa.

Mr. N. L. Smithian has been appointed assistant superintendent of motive power of the Missouri, Kansas & Texas of Texas, with office at Dennison, Tex.

Mr. P. Dickson has been appointed foreman of the mechanical department of the Stephensville, North & South Texas, with office at Comanche, Tex.

Mr. W. Renix, formerly locomotive foreman of the Canadian Pacific at Moose Jaw, Sask., has been tranferred to a similar position at Sutherland, Sask.

Mr. B. McBride, formerly master mechanic of the Southern at Charleston, S. C., has been transferred to Columbia, S. C., in place of Mr. C. G. Arthur.

Mr. Oscar C. Dibble has been appointed erecting foreman of the Rock Island at Cedar Rapids, Iowa, in place of Mr. W. A. Yonda, who has resigned.

Mr. Frank West has been appointed master mechanic of the Hayneville & Montgomery, with office at Hayneville, Ala., in place of Mr. G. C. McCutchin.

Mr. F. T. Chase has been appointed master mechanic of the Southville district of the Missouri, Kansas & Texas railway of Texas, with office at Smithville, Tex.

Mr. George O. Hammond has been appointed assistant to the mechanical superintendent of the New York, New Haven & Hartford, with office at New Haven, Conn.

Mr. M. D. McKenna, formerly master mechanic of the Ventura County, at Oxnard, Cal., has been promoted to superintendent of motive power at the same place.

Mr. W. L. Cooke has been appointed erecting foreman of the Southern Pacific at Houston, Tex., in place of Mr. W. T. Berger, who has been assigned to other duties.

Mr. Harry S. Rauch formerly apprentice instructor of the New York Central & Hudson River at Oswego, N. Y., has been transferred to a similar position at Avis, Pa.

Mr. G. W. Gilleland, formerly general foreman of the Seaboard Air Line at Monroe, N. C., has been transferred to a similar position on the same road at Hamlet, N. C.

Mr. S. T. Park, formerly superintendent of motive power of the Chicago & Eastern Illinois, resigned to become president of the Monarch Pneumatic Tool Co., St. Louis, Mo.

Mr. W. A. Larick has been appointed road foreman of engines of the Lake Shore & Michigan Southern, with office at Toledo, Ohio. He succeeds Mr. Geo. M. Birker.

Mr. A. McArthur, formerly locomotive foreman of the Canadian Pacific at Sutherland, Sask., has been appointed general foreman on the same road at Revelstoke, B. C.

Mr. H. W. Ridgway, formerly master mechanic of the Colorado & Southern at Denver, Colo., has been appointed super-

intendent of motive power and car department, in place of Mr. C. Van Buskirk, resigned.

Mr. A. Schlitz has been appointed road foreman of engines of the New York Central & Hudson River, with office at West Albany, N. Y. He succeeds Mr. E. J. Clements.

Mr. J. R. Tierney has been appointed road foreman of engines of the Parsons district of the Missouri, Kansas & Texas, in place of Mr. C. I. Evans, who has been promoted.

Mr. J. H. Dougherty has been appointed acting master mechanic of the Waco district of the Missouri, Kansas & Texas railway of Texas and the Texas Central, with office at Waco, Tex.

Mr. W. B. Bunn has been appointed general foreman of the Queen & Crescent, at Danville, Ky., and Mr. J. G. Lewis has been appointed to a similar position on the same road at Ludlow, Ky.

Mr. J. H. Tinker, formerly master mechanic of the Chicago & Eastern Illinois at Danville, Ill., has been appointed acting superintendent of motive power, in place of Mr. S. T. Clark, resigned.

Mr. H. D. Jackson has been appointed general master mechanic of the Alabama, Tennessee & Northern and the Tombigbee Valley, with headquarters at Panola, Ala. The shops at Calvert, Ala., are also under his charge.

Mr. Harry Feathars has been appointed master mechanic of the Louisville & Nashville, at Corbin, Ky., in place of Mr. Harry Hardie, who has been transferred to a similar position on the same road at Howell, Ind.

Mr. E. J. McMahon, formerly general foreman of the Southern Pacific at Houston, Tex., has been appointed shop superinendent at Houston, in place of Mr. M. J. McGraw, who has been appointed to a position on the Chicago & Alton at Bloomington, Ill.

Mr. Edward T. Hendee, assistant to the president of Joseph T. Ryerson & Son, has assumed the duties of railroad sales manager, with headquarters in New York, made vacant by the resignation of Mr. Gilbert H. Pearsall, who is to engage in business for himself.

Mr. J. P. McAnany has been appointed district master mechanic of the Canadian Pacific, from Revelstoke, B. C., to Moose Jaw, Sask., and Mr. A. Mallinson, formerly general foreman of the same road at Revelstoke, has been appointed district master mechanic at Nelson, B. C.

Mr. D. Hartel has been appointed assistant road foreman of engines of the Chicago division of the Baltimore & Ohio railway of Indiana, with office at Peru, Ind., and Mr. O. A. Hoffman has been appointed assistant to the road foreman of engines on the same road in charge of the instruction of firemen.

Mr. John Benzies has been appointed supervisor of locomotive operation of the Chicago terminal and Illinois divisons of the Rock Island Lines, with office at Chicago, Ill. Mr. Benzies has special supervision of all mechanical operations on the locomotives looking towards improving economies on the use of general supplies and on the maintenance of the engines.

Mr. Miles Bronson has been appointed general superintendent of the electric division of the New York Central & Hudson River Railroad with office at Grand Central Terminal, New York, and Mr. Garret H. Wilson has been appointed superintendent of the same division at the same place, and Mr. Wilson has also been appointed superintendent of the Grand Central Terminal.

Mr. W. G. Rose, formerly master mechanic of the Cincinnati, Hamilton & Dayton at Indianapolis, Ind., has resigned to accept a position as mechanical superintendent of the Procter & Gamble Manufacturing Company, Cincinnati, Ohio. This is one of the largest concerns of its kind in the world, having factories in New York and in Kansas City. The Cincinnati factory is much larger than the other two factories. The company operates its extensive plants on a profit sharing plan, each employee being a stockholder in the business.

WILSON E. SYMONS.

Mr. Joseph Chidley, formerly division master mechanic of the Lake Shore & Michigan Southern at Collinwood, Ohio, has been appointed assistant superintendent of motive power of the Lake Shore & Michigan Southern, the Dunkirk, Allegheny Valley & Pittsburgh, the Chicago, Indiana & Southern and the Indiana Harbor Belt, with office at Cleveland, in place of R. C. Dickerson, transferred, and Mr. O. M. Foster, formerly master mechanic of the Lake Shore & Michigan Southern at Elkhart, Ind., has been appointed master mechanic of the Lake Shore division, with office at Collinwood, in place of Mr. Joseph Chidley, promoted. Mr. M. D. Franey, formerly assistant division master mechanic at Collinwood has been appointed master mechanic at Collinwood, succeeding Mr. O. M. Foster, and Mr. B. F. Kuhn, formerly superintendent of shops at Collinwood, has been appointed assistant mechanic at Collinwood, succeeding Mr. B. F. Franey.

Mr. Chidley entered the company's service as a machinist in 1890 and was promoted to machinists' foreman at Englewood, Ill., in 1900. From that date his promotion was rapid and he was in charge of the company's shops at Air Line Junction, Elkart, and latterly at Collinwood, where he was master mechanic nearly seven years. His record is an excellent one, and he is very popular among the railroad men.

Mr. Wilson E. Symons, who has been doing expert railway work for several years in the way of estimating the value of railway property for stockholders and others, has accepted the position of superintendent of motive power of the San Antonio & Aransas Pass Railway with headquarters at San Antonio, Tex. Mr Symons has gone through an eventful career as a railway man and has passed with high credit through several important positions. He received an academic education in an Indiana school and has kept up his education by the study that comes from innate love of knowledge He went through four years training as machinist apprentice, then widened his experience and skill by filling the position of locomotive fireman long enough to be advanced to the right hand side which he occupied for several years. Then we find him doing special engineering work for which he had decided aptitude. By the process of natural selection he became general repair shop foreman, master mechanic and superintendent of motive. He left that position on the Chicago Great Western to engage in expert investigation of railway property, which he followed until he accepted the Aransas Pass position. About a year ago Mr. Symons took up the question of Scientific Management and in a very exhaustive paper read before the Franklin Institute entitled "The Practical Application of Scientific Management in Railway Operation," exposed the fallacies of many theorists who had been assailing railway management.

Attention.

Through force of circumstances there are at present several good master mechanics and several shop foremen looking for positions. If any official who has the hiring of such men can make use of any of them we shall gladly bring them together, and we know that the result would be to their mutual advantage.

Hydraulic Bulldozer.

This machine was recently designed by the Watson-Stillman Company, New York, for manufacturers of heavy axles, but it may also be used for upsetting or shaping heavy forgings for die press work

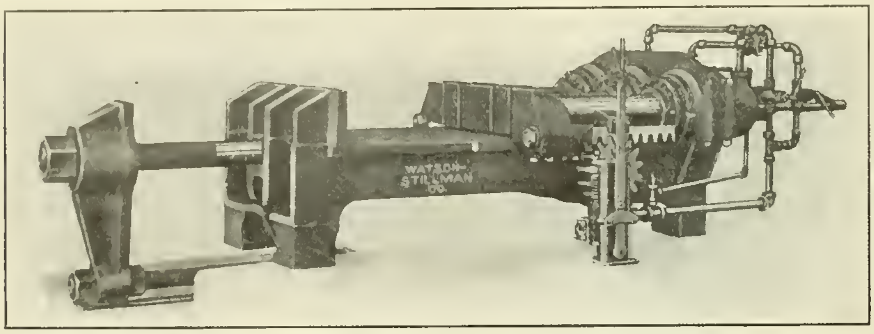
For example, a round or square steel bar which is to be upset or split at one end and then shaped to the required form, is put on the bed plate with the other end against the heavy upright beam shown at the extreme left. A slot, provided in the rigid cross beam between the two middle stiffening ribs, is large enough to handle almost any size of bar or shape up to or beyond the full capacity of the machine. The upright stop on the left is then adjusted to its correct position by means of the nuts on the two horizontal rods. The correct position of this beam is determined by the length of bar that must project onto the bed plate clear of the face of the rigid crossbeam.

A forming die, a cutter, or whatever is needed to give the bar its initial cut or shape is rigidly attached to the moving crossbeam, the face of which is shown in the cut. (The four vertical T slots in the moving crossbeam furnish ample means for attaching dies.) A forming or holding die is also placed against the fixed cross beam to guide or shape the operation. Where many pieces of the same size must be formed, the die is not removed until all pieces are ready for another operation if needed.

A notable feature of this machine is the arrangement of its three rams, all connected to the one head to permit the use of only one, of two, or of all three rams, depending on the pressure necessary. With one ram—the middle one—the capacity of the bulldozer is 56 tons; with the two outside rams, 127 tons; and with the three cylinders in use simultaneously the capacity becomes 200 tons. Stop valves, show in the piping at the rear, are used for cutting out the cylinders.

The press is completely controlled by the vertical latch lever shown, which operates a 2-inch balanced two-spindle valve. A 5-inch pullback cylinder, not shown, is constantly under pressure to return the moving crossbeam to its initial position as soon as the rams are released. The stroke of the rams is limited to 15 inches by positive stops which are strong enough to take up the full pressure. These stops serve as safety devices in preventing excessive upsetting on certain forgings. To allow for eccentric loads on the moving crossbeam an equalizing device consisting of two racks and two pinions is provided to insure absolutely parallel motion. One pinion and one rack of this device are shown in the picture.

The width of the bed plate is 44 inches; maximum opening between moving crossbeam and rigid crossbeam 48 inches; maximum opening between moving crossbeam and adjustable stop, 90 inches; length of moving crossbeam, 48 inches; diameter of rams, 11 inches; stroke, 15 inches; maximum liquid pressure per square inch, 1,500 pounds; diameter of horizontal extension bolt, 6 inches. The weight complete is 20,000 pounds.



WATSON-STILLMAN NEW HYDRAULIC BULLDOZER.

Important Change in M. C. B. Co.

Mr. Walter E. Marvel and Mr. Frank A. Buckley have jointly purchased the interest in the M. C. B. Company, formerly owned by Mr. Earl C. Cowgill, and Mr. Cowgill, we understand, has accepted a position as manager of a large plantation in Mississippi. The M. C. B. Company has made numerous changes in its clientage and management since the first of the year, and all point to a most prosperous and satisfactory outlook for the future. Mr. Marvel, the president of the company, is a railroad man of long experience, and Mr. Buckley is an old-time supply man, both gentlemen being thoroughly conversant with the business of selling railway equipment and both possessed of a host of friends who wish them continued success.

Goldschmidt Thermit Calendar.

Something new in calendars is published this month by the Goldschmidt Thermit Company, 90 West street, New York. Beginning with March and ending with February next year, the page for each month illustrates some particular device or method in relation to the company's fine products. Scenes of actual operations are presented on photographic reproductions on toned paper with brief and interesting descriptive matter, the whole forming an excellent panorama of the progress that is being made in the application of thermit welding. All of the illustrations are new and striking, the application of thermit seeming to run with mercurial swiftness into many unexpected situations, such as the welding of new teeth into large gears, driving wheel spokes, connecting rods, mud rings and cross-heads. In this work it may be noted that there are approximately 345 railroad shops in North America where welding processes are successfully carried on. The new calendar is unique in design, elegant in presentation of facts, and very interesting. Copies may be had on application to the company's office, New York.

Dixon's Paint.

Last month's *Graphite*, published by the Joseph Dixon Crucible Company, Jersey City, N. J., had an excellent illustration with descriptive matter relating to the new boiler house of the Lehigh Coal and Navigation Company, Hauto, Pa. Apart from the fine view of the great steel structure, it is interesting to learn that Dixon's Silica-Graphite paint was selected for both shop and field coats for the preservation of all steel contained in the structure. Dixon's graphite products have stood the tests of time. They are indestructible.

New Appointments.

The International Inter-locking Rail Joint Manufacturing Company, on account of the rapid increase in business during the last six months, has secured the services of Mr. Burton E. Reed and Mr. Walter H. Lienesch. Mr. Reed has had an extensive railroad experience as a railroad man, and will act in the capacity of assistant to the general manager, while Mr. Lienesch, a consulting engineer, formerly identified with the Illinois Traction System and other companies, will have full charge of the engineering department.

Data on Keystone Boxes.

The Keystone line of locomotive driving truck and trailer boxes, as described in previous issues of RAILWAY AND LOCOMOTIVE ENGINEERING, has rapidly forced its way to the notice of prominent railway officials. The railway engineering department of the Keystone Lubricating Company, of Philadelphia, Pa., has systematically and conscientiously tested these boxes under varied and trying conditions with the result that today they can point with pride to some of the most astonishing results ever attained in this line of endeavor. One report of a test of Keystone Truck boxes shows a mileage of about 3000 miles on 2 ozs. of Keystone grease, or an equivalent of 24,000 miles per lb. per journal, and no sign of wear on brass, hub-liner, nor box.

RAILROAD NOTES.

The Great Northern has ordered 15,000 tons of rails from the Illinois Steel Company.

The Pennsylvania has ordered 80 freight locomotives to be built at the company's shops.

The Louisiana & Arkansas has ordered 4 ten-wheel locomotives from the Baldwin Locomotive Works.

The Western Maryland railway has ordered 8,400 tons of rails from the Carnegie Steel Company.

The Louisiana and Arkansas has ordered 4 ten-wheel locomotives from the Baldwin Locomotive Works.

The Louisville & Nashville will spend about $20,000 in enlarging its shops at Howell, Ind.

The Atlantic Coast Line has ordered 1,000 box cars and 300 flat cars from the Barney & Smith Car Company.

The Chicago, Rock Island & Pacific have ordered 25 Mikado locomotives from the Baldwin Locomotive Works.

The Michigan Central has ordered 15 six-wheel switching locomotives from the American Locomotive Company.

The Illinois Central has begun work on the extensive new shops to be constructed at East St. Louis, Ill.

The Louisville & Nashville has ordered 500 gondola cars from the Mt. Vernon Car & Manufacturing Company.

The Baltimore & Ohio is said to have placed orders for 10,000 tons of rails with the Cambria Steel Company.

The Missouri Pacific is having plans prepared for the erection of a new roundhouse and machine shop at Joplin, Mo.

The Chicago, Rock Island & Pacific has ordered 1,000 box cars from the Western Steel Car & Foundry Company.

The St. Louis, Southwestern has ordered 10 consolidation locomotives, and 10 ten-wheel locomotives from the Baldwin Locomotive Works.

During January of the present year the Illinois Central let contracts for 55 new locomotives and 6,000 coal cars. The cost will approximate $8,000,000.

The largest railway repair shop is said to be that of the London & Northwestern at Crewe, England, where about 10,000 men are constantly employed.

The Chicago & Alton has completed arrangements for building a new roundhouse and machine shop at Slater, Mo. The present machine shop will be used as a blacksmith shop.

In addition to a large number of new locomotives in course of construction at the company's shops, the Pennsylvania has placed orders with the American Locomotive Company for 40 superheater consolidation freight locomotives.

The Norfolk & Western has ordered 40 Mallet locomotives from the American Locomotive Company. These locomotives will have cylinders 22 ins. and 35 ins. by 32 ins., with 56 ins. driving wheels, and will weigh about 405,000 pounds.

The Duluth, South Shore & Atlantic has ordered 12 superheater consolidation locomotives from the American Locomotive Company. These will be adapted for freight service and will have cylinders 21 ins. by 28 ins., with 55 ins. driving wheels, and will weigh about 185,000 pounds.

The Grand Trunk is reported to have ordered 25 passenger locomotives from the American Locomotive Company, 50 Pacific locomotives from the Baldwin Locomotive Works, 10 of the same type from the Montreal Locomotive Works, and 15 switchers from the Canadian Locomotive Works.

President Chamberlin, of the Grand Trunk railway, has raised $6,000,000 to help in the scheme of extending the Grand Trunk lines through New England to Boston. The interests opposing the movement are large, and there is considerable opposition to the plans of the Grand Trunk.

Railroad companies are noted for the help they extend to farmers in the regions they traverse. One of the latest helping hands has been held out by Mr. W. W. Walker, general manager of the Duluth, South Shore & Atlantic, who is loaning stump pullers to the farmers along the company's lines at the nominal rent of $1 an acre for the land cleared.

The Southern Pacific & Central Pacific last month celebrated the fiftieth anniversary of the beginning of the construction work of the Central Pacific system. A bronze tablet was unveiled at Sacramento, Cal., on the spot where Governor Leland Sanford turned the first shovel of earth. Every wheel on the system stopped for five minutes on the day of the celebration.

Compliment to Our President.

Dr. Angus Sinclair attended a recent meeting of the Pittsburgh Railway Club and was dined by the committee before the ordinary business began. When the first order of business came round, President A. G. Mitchell said: "Before taking up the paper of the evening, I wish to ask if we can have a few words from our fellow-member, that Grand Old Railroad Man of New York, the president and editor of RAILWAY AND LOCOMOTIVE ENGINEERING, whom we have all known by reputation, if not personally, and whom it has been my great pleasure to have known for many years. I now have the pleasure of introducing to you Dr. Angus Sinclair."

Dr. Sinclair, after acknowledging the high compliments paid him by President Mitchell, said: "I am one of the oldest of Railway Club members, and consequently I have enjoyed a great deal of experience in these club meetings. From what I have seen and learned of them I consider that they are doing a wonderfully useful work for their members.

"We hear a great deal nowadays about educational work. Education and its needs are repeated concerning every department of industry and endeavor, and strenuous efforts are going on to improve the education of all classes. In regard to railway men such as are drawn to these meetings, I think the railway clubs exercise as useful an educational influence as anything that has been tried for the benefit of our associates and friends.

"When I joined the Railway Master Mechanics' Association many years ago there was no railway club organized, and it was very difficult to induce members of the Master Mechanics' and Master Car Builders' associations to take part in discussions; but as soon as the railway clubs began to make their training felt, there was no lack of speakers at any meetings. Until the clubs with their social, homelike air began to encourage members to express their views in meetings very few persons took active part in the meetings of the National associations. They were mostly plain mechanics who had not been accustomed to expressing their views while standing before an audience, so they instantly became nervous and forgot what they were going to say. That was frequently a loss of useful information. Nowadays I notice in the larger associations such as the Master Mechanics, the Master Car Builders, the Traveling Engineers, etc., that whatever subjects come up for discussion there are plenty of speakers ready to express their views, and nearly always give valuable information on subjects they are familiar with.

"There is no doubt that this change is due to the training received in railway club meetings. At every meeting which I attend, I listen to men giving out with fluent speech information of a valuable character that adds to the technical knowledge of everybody present. I can look back a few years to the time when I heard some of the same fluent speakers stumbling at every sentence, oppressed with the knowledge that people were listening to their words. Practice, however, has made many of you perfect.

"'Let us reason together' is a wise injunction from a supreme source. But it means more than the bald 16th century English expresses. It means let us exchange the knowledge that we each have acquired. That is the purpose and the practice of the railway clubs."

A Useful Dog.

Among curious patents invented as railway car accessories one reads: "Pressure upon a seat throws into gear a reciprocating gear head which at each backward movement interlocks a spring dog, which actuates the register as it swings over the dog. The dog is immediately afterwards forced down and locked, ready to be again released by the reciprocating head."

The purpose of that invention is to automatically register the number of passengers who occupy seats in a car. It makes no notes of strap hangers.

The dog is of a species that never sleeps. If the inventor can extend its usefulness the success of the animal will be assured. The dog must be trained to grab the leg of the man who twists himself round two seats and obtrudes his muddy feet into the aisle where they scrape mud upon every passer by; it ought to arouse the sleeper who snores louder than the locomotive whistle; it ought to restrain the ardor of the butcher who shouts his wares more than twenty-five times an hour; it ought to bark at the person who insists on keeping a window open to admit smoke and cinders. Should these duties be performed faithfully for six months we will suggest others to the attention of the faithful canine.

Returning to Prose.

Flushed with triumph and 90 degrees in the shade, parched and scant of breath, they stood upon the towering mountain peak and surveyed the gorgeous panorama that spread itself beneath them like a two-inch to the mile ordance map of the whole world.

"There!" she exclaimed angrily. "We have climbed all this distance to admire the beauties of nature, and we've left the glass at home!"

Tranquilly smiling, he shifted the lunch-basket to the other arm.

"Never mind, dear," he replied. "There's nobody about. It won't hurt us just this once to drink out of the bottle."

You are working for yourself when you hire a good man to work for you.

Smoke the Great Prophylactic.

A discussion having arisen in the New York Evening *Sun* about smoking the following letter appeared:

To the Editor of The Evening Sun.—Sir: The letters which have recently appeared in your pages concerning smoking, moves me to say a few words about another kind of smoke, for which I never heard a good word said by public writers—that is coal smoke.

When steam furnaces first came into use, a certain portion of the public immediately demanded that coal should be burned with entire absence of smoke, because they alleged the black fumes were dangerous to health. (Merely alleged.) Discussing smoke preventing appliances has been part of my business for many years, consequently I am particularly familiar with what has been said and done on that subject.

For many years the opponents of smoke objected to its fumes on the ground that it defiled buildings, anointed the people's clothes with soot and damaged vegetation. Of late years, since Chicago and other places have undertaken a crusade against smoke, they have introduced the argument that smoke is injurious to health and causes a variety of dangerous diseases. My experience goes to prove that smoke is a prophylactic which protects the human form divine from various diseases.

As a railway engineer and engine house foreman for many years I spent a great deal of time in roundhouses which in winter were notorious for smoke, and I found the workmen particularly healthy. When the underground railways in London were operated by steam locomotives, which burned soft coal, the atmosphere was generally dense with smoke, and it is a well known fact that the trainmen and others employed in the old subways were celebrated for the robust health they enjoyed. That fact was mentioned once to my knowledge in the directors' annual report. I have known men who were employed all day working in long smoky tunnels and they were noted as being particularly healthy men. When people denounce smoke as being dangerous to health I demand some proof.

Angus Sinclair,
Editor Locomotive Engineering.

Dean Boiler Tube Cleaners.

The coming of February's issue of Railway and Locomotive Engineering to the writer's desk reminds him of a little piece of news which may interest you.

You know that we have for some time been making Dean Boiler Tube Cleaners for use in locomotive arch tubes. In the first few tests made of this cleaner in cleaning arch tubes it proved a distinct success. So we decided to advertise the fact in Railway and Locomotive Engineering, and recently we secured a trial order from the Illinois Central, at Waterloo, Ia., as a result.

The cleaner was tested out and was found so far superior to other means of removing scale from arch tubes that an order was immediately placed with us for twelve more Deans.

Over half a dozen of the principal railroads have now tested the Dean in arch tubes and have adopted its use.

Yours truly,
The Wm. B. Pierce Co.,
Howard E. Gansworth, Adv. Mgr.

Getting a Raise.

A year ago a manufacturer hired a boy. For months there was nothing noticeable about the boy except that he never took his eyes off the machine he was running. A few weeks ago the manufacturer looked up from his work to see the boy standing beside his desk.

"What do you want?" he asked.

"Want me pay raised."

"What are you getting?"

"T'ree dollars a week."

"Well, how much do you think you are worth?"

"Four dollars."

"You think so, do you?"

"Yes, sir, an' I've been t'inkin' so for t'ree weeks, but I've been so blamed busy I ain't had time to speak to you about it."

The boy got the raise.

Business Is Business.

"But look here," said the indignant antiquary. "In my article on Early Grecian sculpture I distinctly mentioned Phidias. Why has his name been deleted?" The editor smiled quietly. "When," he said, "you find old man Phidias getting his work advertised in this paper under half a dollar a line you come right around and let me know."

A Common Swindle.

Patrick Murphy, while passing down Tremont street, was hit on the head by a brick which fell from a building in process of construction. One of the first things he did after being taken home and put to bed was to send for a lawyer.

A few days later he received word to call, as his lawyer had settled the case.

He called and received five crisp new $100 bills.

"How much did you get?" he asked.

"Two thousand dollars," answered the lawyer.

"Two thousand, and you give me $500? Say, who got hit by that brick, you or me?"

It is a very natural matter for us to quarrel with results. What we should do is to remedy the cause.

Books, Bulletins, Catalogues, Etc.

The Report of the Proceedings of the Forty-Sixth Annual Convention of the Master Car Builders' Association.

This is a volume of 983 pages besides folded plates one inch thick. It is the most formidable annual report we have ever seen and must represent a wonderful amount of painstaking work on the part of Secretary Taylor. A careful examination of the book convinces us that keen editorial work has been devoted to getting out such a voluminous report practically free from typographical and technical blunders. Our space will not permit us to give even a summary of the contents of the report. What has been pressing upon our mind during the labor of examining the book is that the secretary ought to have his salary raised.

The Stock Exchange.

"The Stock Exchange from Within," is the title of a new book by William C. Van Antwerp, and published by Doubleday, Page & Company, New York. It extends to 237 pages, and is not only the best exposition of the methods in vogue in the New York Stock Exchange, but is the defence of the means and methods in use in that great financial center. In some respects the book is the first one of its kind ever published, and those who are interested in such matters should read this book. It is a challenge to the critics, who are numerous, and mostly always ill informed. It is the work of an individual member of high courage, and uncommonly gifted in clearness of expression. The Stock Exchange may have its faults, but it deserves fair play, and the man or set of men who care to refute the arguments of the book have a big work before them. The book is finely printed and bound, and contains several excellent reproductions of photographs. The price is $1.50.

Dixon's Catalogue.

The largest and most complete production catalogue ever issued by the Joseph Dixon Crucible Company, Jersey City, N. J., is now being mailed to the thousands of manufacturers, jobbers, purchasing agents and others interested in graphite, crucibles, paint, lubricants pencils and the other productions of the Dixon Crucible Company. Though over one hundred pages of type and illustrations are used, this catalogue does not attempt to carry a full description of the entire Dixon line and only a few of the many hundreds of Dixon's American Graphite Pencils are listed. The Dixon Company attach a peculiar value to their production catalogue inasmuch as it serves to acquaint those who are already users of one form of graphite with its many other forms and uses. If you are particularly interested in graphite products you are invited to send for a copy of this catalogue.

Management of Saws.

This is the third edition of this popular work by Robert Grimshaw. It is revised and enlarged and is a practical treatise on filing, gumming, swaging, hammering and brazing band saws; speed, power and work to operate circular saws, etc. Directions are given for filing, setting, joining, straightening and polishing hand, butchers', band and circular saws. It tells what files to use and gives useful hints for the repairing and caring for saws, treats of home-made sets and clamps, emergency repairs, etc. Tables of proper shape, pitch and set of saw teeth, as well as sizes and number of teeth of various saws are included. The book is well illustrated and should be of assistance to anyone who has charge of saws or who uses saws for any purpose. It contains over 130 pages, size 4 x 6⅛ inches, bound in cloth with gilt title. Price, $1. Published by the Norman W. Henley Publishing Co., 132 Nassau street, New York, N. Y.

Interstate Commerce Commission.

The final report of the Block Signal and Train Control Board to the Interstate Commerce Commission has just been published and is of unusual interest, as it is, perhaps, the most exhaustive report yet published on the subject of automatic train stops, the investigation of which was one of the two chief purposes aimed at in the establishment of this board. New and valuable data concerning it are being evolved in regard to the subject, and the most serious attention is being given to it by competent engineers, so that both the science and the art are being developed along more practical lines than formerly. It is very much to be regretted that the chief stimulus to these efforts lies in the recurring collisions due to causes that these devices are intended to prevent. It is not our purpose to recur too frequently to these painful disasters. It is our province to do all that we can to aid in their prevention, and to this end we earnestly urge a careful perusal of the final report of the board referred to, which, we are of opinion, has done its work in a way not common to semi-political bodies, and from the wide publication of the report we are convinced that some real good will come.

Little minds are tamed and subdued by misfortune, but great minds rise above it.

Permanent Manufacturers' Exhibit

Railway Supplies and Equipment

Notes of the Exhibits and Meetings

Ironclad Water Gauges.

The Sargent Company, Fisher building, Chicago, exhibit full details of the Ironclad water gauges, the chief feature of which is the finely tempered curved plate glass with its interwoven wire mesh. It successfully withstands all shocks and stresses from bursting of tubular glasses under maximum steam pressure, the most destructive of which are the expansion force of steam suddenly released from the tube, the impact of glass fragments at high velocity and the sudden rise of temperature, due to the escape of steam and water from the boiler. It combines the quality of affording a clear view of the glass, without allowing the remotest possibility of accident.

Oxy-Acetylene Welding.

The Anderson Manufacturing Company, Tulsa, Okla., with factory and demonstrating plant at Coffeyville, Kan., exhibit a complete plant which is portable, being mounted on steel trucks, and designed for foundries, machine shops, boiler shops and repair shops. The apparatus is designed for welding aluminum, brass, bronze, copper, cast iron, cast steel, iron and steel. It carries extension torch and produces pure, cool gases and neutral flame, and has conspicuously proved its ready adaptability to reclaim imperfect castings, repairing broken or cracked castings of any kind of metal. It is also adapted for cutting steel rails, pipe in any design. It removes sections

resent both the ballast and wooden ties combined. It has the double advantage of maintaining a perfect alignment both in surface and gauge. After long usage the steel has a scrapping value. The bed will never settle in soft ground. It is perfectly water tight. The model shows the complete design which has been thoroughly tested and strongly approved by practical railway men who have examined it and watched it in the track. The complete details will be furnished by the inventor to all interested who may not have an opportunity to examine the model in the exhibition.

Full particulars will also be furnished on application to the company's offices at Bluefield, W. Va.

VIEW OF KARPEN BUILDING AND VICINITY, CHICAGO, ILL.

Valve Stem Packing.

The American Piston Company, Indianapolis, Ind., exhibit a variety of samples of Grapho-Metal packing. This packing has the rare quality of self-lubricating, and of great durability, which is owing to the substantial nature and the heat-resisting qualities of the metal and the efficiency of the lubricant incorporated in it. It is made up into divided rings, is quickly applied and requires very little attention. It is adapted for piston rods, valve stems, throttles, injectors, valves and water glasses, and can readily and permanently be applied on any train from the pilot to the tail light. It has met every requirement and has been in continuous use in severe service, without renewal, in many cases over six years. The company will furnish full particulars and price lists on application.

of boilers. It will cut out a 24-inch circle of ½-inch boiler steel in about six minutes. It will readily save many pieces of machinery, weld flue sheets, engine or truck frames, cast-iron headers, superheater headers, and has even had its merits tested in welding a hand hammer broken through the eye. No filing or dressing is required after the completion of the weld. As a labor saver it is a great success.

Coffman's Permanent Way.

A full-sized model of Coffman's permanent way, invented by W. H. Coffman, Bluefield, W. Va., is on exhibition and is attracting much attention. It consists of a reinforced compacted monolithic bed or permanent way, and is a support for the rails and rail chairs. The chairs take the place of tie plate. The beds rep-

Railway Water Appliances.

The United States Wind Engine and Pump Company, Batavia, Ill., have been established for nearly sixty years and have perfected many devices for the handling and storage of water. Their exhibit of windmills of wood and steel is of the highest type of mechanical construction and efficiency. They are self-governing in storms and automatic in action. They are very economical in pumping water at small stations as well as for stockyard purposes. They also manufacture hand pumps for station platforms, yards and cisterns. The well-known Curtis power pump is exclusively their product. Their wooden water tanks have become a standard by which all other tank work is gauged. It is claimed that the company annually turn out more railroad tanks than all

other manufacturers combined. All kinds of tank fixtures, besides special appliances peculiar to individual railroads are made by the company. In this connection steel towers for supporting tanks, and water columns and stand pipes are too well known to require any extended notice. The same may be said of their switch stands, semaphore signals and semaphore switch stands. This latter line of appliances was added only a few years ago, but is already meeting with marked success. The material and workmanship are excellent.

EAST AISLE, PERMANENT MANUFACTURERS' EXHIBIT.

Crane Company.

The Crane Company, Chicago, Ill., show a working Cranetilt trap exhibit, comprising a boiler, an open tank, Cranetilt direct return trap, Cranetilt lifting trap and a non-return trap. The boiler operates with air pressure for air lines supplied by the Karpen building through a regulating valve with pressure of 80 lbs., and on the low pressure of the valve 20 lbs. The gauges and gauge glasses show the movement of the water out of the boiler, and when the return trap is in operation the water gauge glass shows the movement of the water into the boiler. The indicator, one of the later and more improvements in the mechanism of the traps, provides means whereby a plant with a large number of traps scattered over a large area can be watched very closely and will avoid any tampering without close inspection and avoids much of the care and labor necessary before the introduction of Cranetilt traps.

There are also blow-off valves of globe, angle and other patterns for use on power plant boilers. These valves are of ferrosteel. Straight-way blow-off cocks with compensating spring are also on exhibition. These cocks entirely overcome the troubles incident to the use of iron cocks or blow-off lines of the plug sticking. The wrench is on the small end of these plugs, and the spring takes up all wear of the plug. The stiffness is entirely relieved. Besides these are a full line of valves and fittings for the locomotive, all of much importance to railway men.

United States Metallic Packing Company.

The United States Metallic Packing Company, of Philadelphia, Pa., have largely increased their number of articles exhibited in the Permanent Manufacturers' Exhibit, and the company's display of articles is attracting much attention. Especially noticeable is the King and Multi-angular types of metallic packing for locomotive piston rods, valve stems and air pumps. The Gollmar pneumatic locomotive bell ringer, thousands of which are in use, are also on exhibition, together with pneumatic track sanders of the well-known Leach and other types. There is also a collection of indestructible oil cups for rods, guides and rocker boxes, etc. The oil cups are very substantial and the prices are very cheap. Various designs of cotton swabbing for locomotive piston rods and valves are also exhibited, the whole forming a very interesting and important exhibit.

American Steel Trucks.

The St. Louis Truck and Manufacturing Company, St. Louis, Mo., have been engaged in the manufacture of American steel trucks for over a year and the trucks have been in general use by many of the leading railroads and are meeting the requirements of the service admirably. They easily outlast a half dozen wooden trucks, and are not much dearer than a wooden truck. They are equipped with self-oiling wheels and bearings, insuring easy running and long life. The nose piece and side bars are forged in one piece of open hearth steel, thereby forming one solid frame. There are no welds to break and no bolts to contend with. The cross bars are hung over the sides of the truck frame and are strongly riveted to the frame. The ends of the truck frame are forged into pockets to receive the wooden handles, which are preferable, as they overcome the vibration. The truck weighs less than a wooden truck. The wheels and bearings are made from open hearth machine steel and journals are carefully turned to size. The trucks are made in a variety of forms to suit every conceivable purpose.

Car Foreman's Association.

At the monthly meeting of the Car Foremen's Association, held in the assembly hall of the Karpen building on February 10, Mr. Bruce V. Crandall delivered a very interesting address on "Keeping the Car Between the Engine and the Caboose." Mr. Crandall justly claimed that it is very evident that the earning power of freight cars rightly constructed and equipped is being lessened, due to the fact that all grades of cars are being handled in interchange with them. The ability to take a train over the road is limited (leaving the locomotive out of consideration) by the poorest car in the train. Such a car in a train otherwise consisting of good cars, properly equipped throughout, will limit the service efficiency of the entire train. Such a car is the "weak link in the chain." Such cars may even at times cause serious disaster which, of course, is tremendously expensive. Keeping the car between the engine and the caboose really demands that no car owner should be permitted to force what are often really trouble-making vehicles into general circulation. Such cars as these running about the country are like disease germs; they carry disaster with them. It is a question if railways which spend thought and money to get good and efficient equipment should be obliged to admit to their lines and into their trains, cars which work directly against that efficiency, and are constant elements of danger, let alone tremendous expense. Cars offered in interchange are required to come up to a certain standard, not perhaps the highest, but at least a good commercial standard. Chronic cripples and disease breeders should be quarantined against. They are responsible for the largest percentage of the delays to traffic, and what is periodically called "car shortage."

The complete address has been issued in pamphlet form, and copies may be had by the interested on application to the secretary of the association.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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On the Intercolonial Railway of Canada

The accompanying illustration shows a view of the Ocean Limited train on the Intercolonial Railway of Canada drawn by one of the Pacific flyers, of which there are a large number in service on the road. The equipment generally is of the best, and the perfect working of the road with its rapidly growing traffic, and its almost complete freedom from serious accidents in a country abounding with great natural difficulties in railroad construction and maintenance, together with frequent severe climatic conditions, are excellent illustrations of the success of governmental management of a railroad. Whether the same success could be obtained under government control in the United States, with its ever changing kaleidoscope of political parties and factions, whose leaders must be provided for, we would not care to venture an opinion. Suffice it to say that the Intercolonial is a model in its way, from which many larger roads might well take many lessons.

There are now nearly 1,700 miles of road in operation of the standard 4 ft. 8½ ins. gauge, with 397 locomotives, 447 passenger cars, and 12,025 freight and miscellaneous cars. There are also 78 snow plows occasionally in service. There are also many steamer connections for hundreds of miles, the road traversing the most varied and inviting scenery.

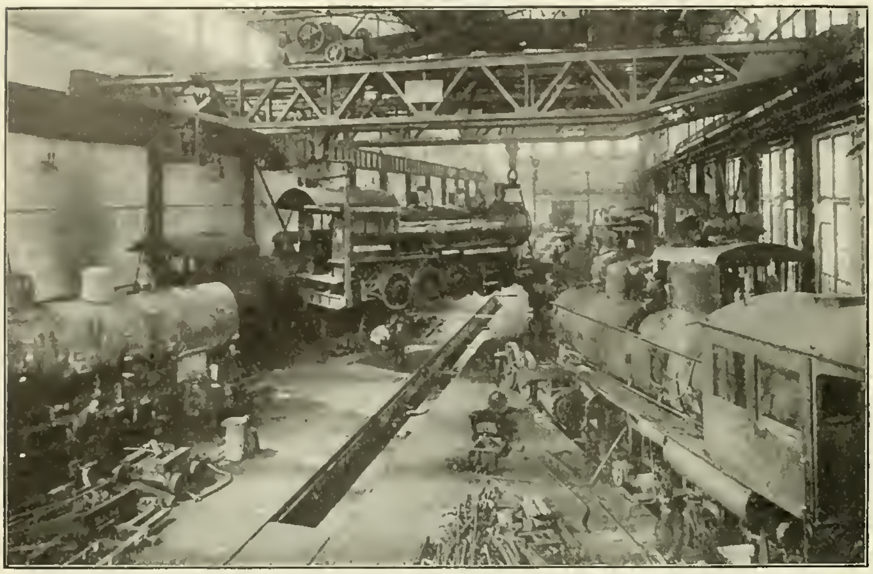
Starting at Montreal, the Intercolonial crosses the Victoria Jubilee Bridge on the St. Lawrence, and takes the shortest route to Quebec which is full of historic interest. Passing along the southern shore of the St. Lawrence the road makes its way among picturesque French-Canadian villages, after which the romantic and beautiful scenic wonders of the mountainous districts is passed until Dalhousie on Chalein Bay is reached. Here the great moose hunting and big game territory begins. A string of thriving towns has recently sprung up all along the road through New Brunswick. At Moncton the strange tidal phenomenon known as the Bore is first seen, and forms a remarkable feature of this interesting country.

THE OCEAN LIMITED. BETWEEN MONTREAL, ST. JOHN AND HALIFAX. INTERCOLONIAL RAILWAY OF CANADA.

Near Moncton is Point du Chene where steamers connect with the Prince Edward Island railway, the main line continuing to the furthest point of Nova Scotia, at Sydney, which together with North Sydney, is rapidly becoming a great commercial center. A separate

branch runs south through the center of Nova Scotia to Halifax. This is the headquarters of the Canadian Naval service, and until recently the British North American Naval Station. It is now garrisoned by Canadian troops. The entire route from Montreal to Halifax or Sydney is of surpassing interest and the road, and equipment, as we have already stated, is among the very best in North America.

In regard to the principal repair shops which are located at Moncton, it will be recalled that they were completely destroyed by fire in 1906, and plans were immediately made for extensive works which now completed are among the largest and best equipped shops in America. The locomotive erecting shop is 375 feet by 80 feet, and is more than twice as large as the old shops and is arranged in departments each caring for certain similar parts of rolling stock. The machines are mostly motor driven. The pits are placed at an angle, or herring bone fashion to economize space. Two sixty-ton electric cranes handle locomotives and all material needed in repairing the same. The machine shop proper is divided into two bays, each served by a ten-ton traveling electric crane. These serve every machine tool, thereby abolishing hand and air cranes and leave the shop light and open.



TWO SIXTY-TON ELECTRIC OVERHEAD TRAVELING CRANES LIFTING A LOCOMOTIVE WEIGHING 120 TONS. I. C. R. SHOPS, MONCTON, N. B.

The brass and tool room is situated on the northwest side of the machine shop, and compares favorably with the old shop, having 3,800 sq. ft. more floor space. The brass foundry adjoins and between the two are placed racks for storing the castings on their way to the brass room. In the tool room where small tools are stored is located a grinding department. This is a new department wherein new tools are made and those in use reground.

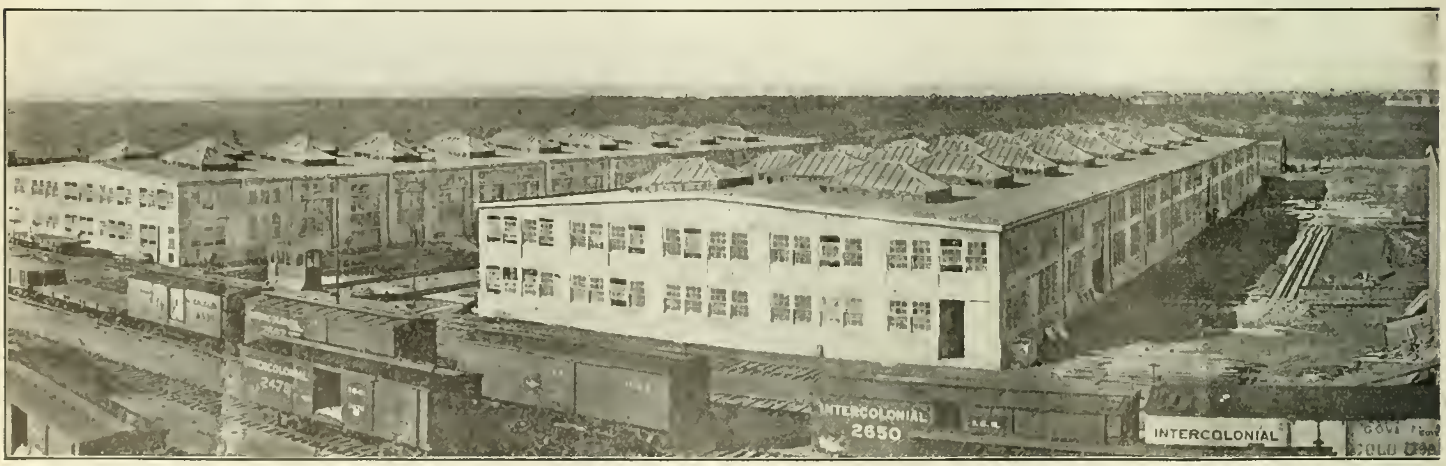
The passenger car and paint shops comprise two buildings each 361 feet by 100 feet and are built to handle 34 passenger cars; 22 was the capacity of those shops destroyed by fire. Between the shops is placed a traveling table on which the cars are placed for transfer to or from either shop or to the yard. This out-door table is placed well above the ground, so as to be clear of snow.

The freight car repair shop is arranged to accommodate 42 cars and the adjoining planing mill is 203 feet by 82 feet. Only heavy lumber for freight and passenger cars is handled here. All of the new machines and also quite a number of the old machines are driven by separate motors; some of the related machines are grouped. The power-house, 203 feet by 62 feet, is divided into two parts, and in one is placed three boilers of 500 horse power each, and two fans for supplying heated air to the blacksmith and freight car repair shops. In the other part of the power house two 500 horse power tandem gas engines direct connected with 300 kilowatt generators supply power to the shops. An air compressor of 2,000 cubic feet per minute capacity supplies air for all pneumatic purposes.

The boiler shop, 225 feet by 100 feet, is equipped with a 35-ton travelling electric crane and a full complement of the latest machinery. A 10-ton crane is also in operation on one side of the shop. The smith shop, 375 feet by 75 feet, is equipped with furnaces operated by natural gas which has been found a short distance away. There are 24 forges arranged in pairs and 5 large single forges. A number of steam hammers are in operation. The smoke is carried out beneath the floor by the down draft system, leaving the shop entirely clear of smoke.

The planing mill is situated convenient to the passenger car shop and freight car shop. The locomotive shops comprise the machine shop and annex, boiler shop, boiler erecting shop, engine erecting shop, and smith shop, all under one roof. The four latter shops are parallel to the main line, but at right angles to the machine shop.

A notable feature in connection with the engine erecting shop is the arrangement of the pits. The main pit runs al-



CAR SHOPS OF THE INTERCOLONIAL RAILWAY, MONCTON, N. B.

most the entire length of the shop, while the track is continued across the machine and passenger car shops into the paint shop, where locomotives may be painted should the erecting shop be crowded. The side pits are all laid at an oblique angle to the main pit, and this arrangement provides greater facilities for stripping and repairing engines.

The Intercolonial has, in addition to the large repair shops at Moncton, other shops at River du Loup and the Prince Edward Island Railway, which is a part of the Government Railways system, and operated by the same management and officials with headquarters in Moncton with large repair shops at Charlottetown, Prince Edward Island.

At the Moncton shops the output is fifteen general locomotive repairs and rebuilds per month, and the passenger car repairs are about 25 and the freight car repairs about 2,000 per month. Some car building is also done, about 100 freight cars per year being turned out recently.

The Producer Gas Plant supplied by R. D. Wood Co., has been shut down, as natural gas has been discovered near Moncton, and is being used in the Westinghouse gas engines, and also in all the furnaces in the blacksmith and boiler shops and brass foundry.

Power is being generated by the gas engines for 1.167 cents per k. w. hour at the switchwoard for operation and fuel, the cooling water forming a large part of this at about .225 cents per k. w. hour. These engines are giving perfect and satisfactory service, and have been in use three and one-half years, the last three months on natural gas.

a continuous line the tracks that go to make up its total would reach from Moncton Station to a point one mile beyond Sackville, a distance it takes the Maritime Express one hour and nineteen minutes to cover.

We cannot close this brief sketch of the Intercolonial railway and the principal repair shops without alluding to the fine appearance of the skilled mechanics employed in the works. We cannot recall seeing a better body of men engaged in mechanical occupations. They have the rugged and stalwart look of Western men, perfected by Eastern methods of training. They are not only physically active but their faces are luminous with high intelligence. The cheap help, so common in some railroad centers, is conspicuous by its absence, and one can see at a glance that it is no great task to keep railroad equipment in such fine condition with such fine men.

A word may be added in regard to the kindly feeling existing between the thousands of employees and the officials. Government employees are usually more or less hampered with what is known as red tape. If there be such a demoralizing thing on the Intercolonial railway it is not visible to the naked eye. Mr. G. R. Joughins, superintendent of motive power, who has been for many years prominently and honorably identified with the mechanical department of the railway, has always taken the warmest interest in the welfare of the skilled workmen under him. The training of apprentices under his admirable methods is of the best, and the loyalty and kindly feeling existing between the heads of departments generally and the workingmen are reciprocal and genuine. Mr. W. E. Barnes, master mechanic, and Mr. H. D. Mackenzie, general locomotive foreman, are the right men in the right places; keeping abreast of the times and kindling by their example a spirit of emulation and a proper pride in the work in which they are engaged.

POWER HOUSE, SHOWING ONE OF THE 500-HORSEPOWER GAS ENGINES DRIVING 300 KILOWATT GENERATOR. I. C. R. SHOPS, MONCTON, N. B.

LOCOMOTIVE SHOPS OF THE INTERCOLONIAL RAILWAY, MONCTON, N. B.

The yards are among the most extensive in Canada, and their construction is said to have cost more than the shops. They are divided into receiving and despatching yards to and from St. John, Halifax, and Montreal. They cover some three hundred acres of ground and contain ten separate yards with a total mileage of thirty-nine miles; or if laid in

General Correspondence

Slide Valve Feed Valve Test Rack.

Editor:

The slide valve feed valve is a part of the air brake equipment that demands a rigid and careful test, before it is put into service. It is one factor upon whose functions rest to a very great extent the successful performance of the rest of the equipment in braking efficiency. It may be argued that perfect workmanship requires no test of its results, but considerable experience in the repair of slide valve feed valves will only too clearly bring out the fact that these little devices are not unlike individuals—each one possesses different characteristics and peculiarities.

In the construction of any local shop tool or device there is always one thing primarily considered and that is the expense of manufacture; this consideration, however, in most cases is regarded as secondary when practical utility has been demonstrated. However, in the local manufacture of a test rack for slide valve feed valves, this primary consideration of cost is reduced to a minimum insomuch as a great portion of the material in its construction is generally on hand in the shop store-room in the class of second-hand but usable material.

The rack bench itself shown in Fig. 2 can be constructed for a wage outlay of less than $5.00. This also includes the cost of placing and banding the two reservoirs to the under side of the bench top.

Fig. 1 illustrates the plan of piping and shows the location of the various cut-outs, bleeds, drains and gauge taps. Fig. 3 is in rough an assembly of the entire arrangement, showing a style of piping found most accessible for rapid work by the writer. The operation of the rack in making a test of a valve is very simple indeed. Two of the tests to which the valve may be subjected are as follows:

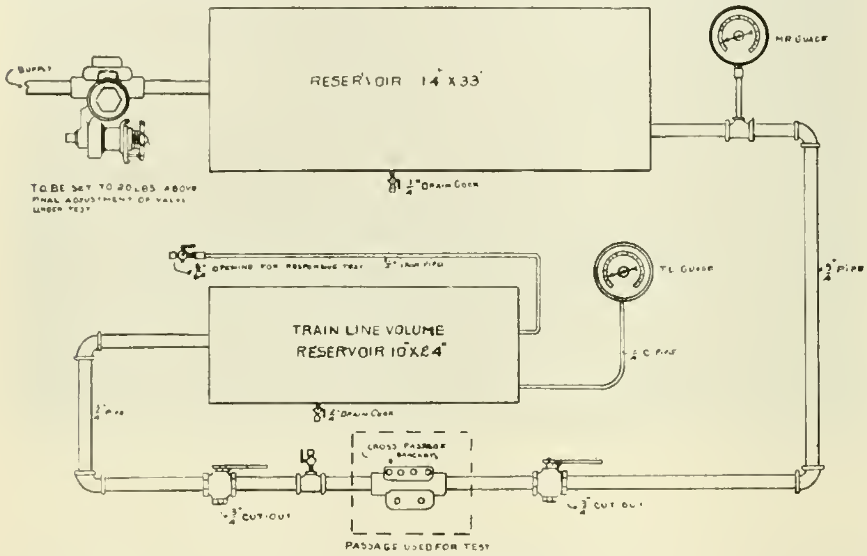


FIG. 1. PIPING DIAGRAM.

1. Leakage test of main and regulating valve. This is accomplished by opening the left-hand cut-out slowly below the slide valve on trial which must not have the adjusting spring box, diaphragms and ring applied. Equalization will, however, take place past the piston, retaining or permitting the slide valve to remain over the supply port. By means of a lighted match or torch a leak past the regulating valve is readily detected. A main valve leakage is, of course, at once detected by the escape of air from the return port opening into the diaphragm chamber.

2. Main piston and responsive tests. These tests are made by the use of the right-hand cut-out and the small bleed cock leading from the rear of the smaller or train line volume reservoir. The writer does not deem it necessary to dwell at length on the manner of making these and other tests in detail, as any air man is familiar with them, or able to reason them out for himself. However, for practical results in accurate testing, for minimum cost of initial manufacture and simplicity of operation, the above device is hard to equal in the line of locally constructed testing apparatus.

F. W. Bentley, Jr.

Huron, S. Dak.

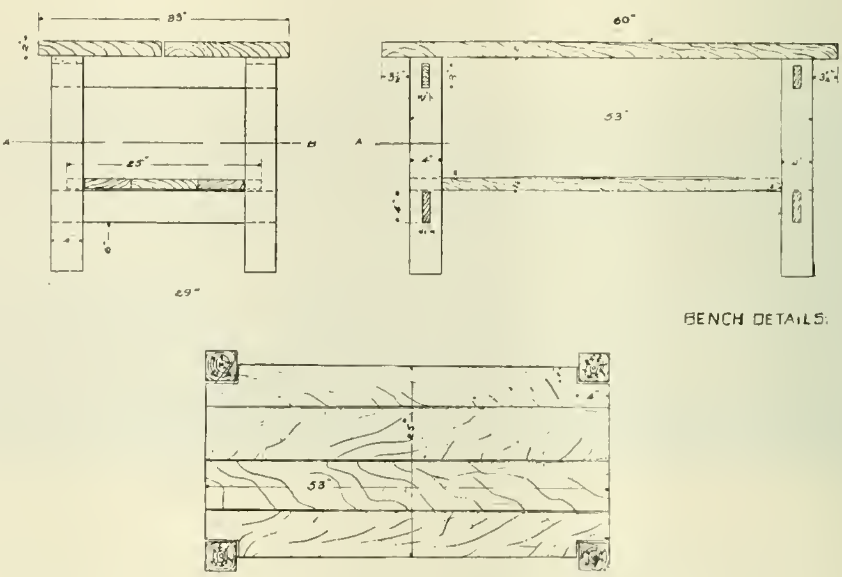


FIG. 2. DETAILS OF RACK BENCH.

Boiler Explosions.

Editor:

Ever since the railroad master boiler makers explained their troubles to me at the Buffalo convention in May, 1905, I have made a constant study of the conditions existing in locomotive boilers and find that, on account of the extended dimensions required to move the traffic of today, of the boilers and the fireboxes in them, a condition of weakness exists which must be met at once if more lives are not to be lost.

The condition is: that the flat plates drawn out to these extended lengths

weaken and crack under the constant expansion and contraction, breaking the staybolts that hold the plates together. A flexible staybolt has been largely used to accommodate the movement of these flat plates, in the error of thinking it will prevent the breakage of staybolts and cracking of firebox plates. This it will not do, as has been conclusively proved to me, for the reason that it is not possible to adjust all these stays in the breaking zone of the firebox, to have equal tension on the plates. Hence it will be seen that the fixed stays around them have to take all the strain of the loose tension of the flexible stays and consequently the fixed stays have full strain brought on them, and with the excess pressure it is too much and the boiler explodes. But, instead of giving these reasons, the causes for boiler explosions are usually summed up, "The boiler being short of water."

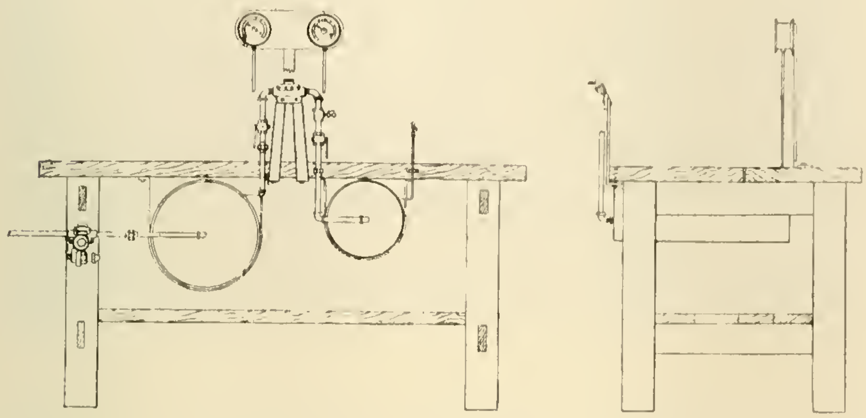


FIG. 3. ASSEMBLY.

This was given as the cause of the explosion at Cosgrove, Nev., on October 3, 1912, of a consolidation boiler. But the federal boiler inspector forgot to report how many stays he found broken in the staybolt area and around these flexible stays. His diagram clearly designates the sides of the firebox blown in, and the fusible plugs in crown of firebox remained intact, therefore there must have been water in the boiler, the more so since he afterward proved the fusible plugs to be correct. They would have fused at the usual temperature. Hence this proves that the crown of the firebox had not been heated to the fusing point to melt the plugs, and it is a mystery to me how he accounts for the explosion by bad water. If these bad water conditions exist and are the cause, then every locomotive in this district is doomed and the engineers and firemen with them.

Again the large Mogul engine which went to destruction in the yard at San Antonio some months back, without any warning whatever, had her usual contingency of water. This explosion caused the loss of property reported at $250,000, to say nothing of the frightful loss of life. So I am afraid it is only too true about the structural weakness of flat plates, and there is no cause to continue them when you can substitute a flexible plate which, according to the United States Marine Laws and the British Board of Trade Regulations, will be eight times the strength of the rigid plate, and will eliminate stays to the number of 750, thus, of course, lessening the danger from broken stays, since there are just so many the less to break.

I repeat that these extended fireboxes of the large locomotive boilers must be met by great consideration and at once, unless we want to have the above mentioned experiences repeated, and each time with increasing fatalities, until we wonder why on earth the subject has been left to take care of itself so long. The same construction has been used ever since the locomotive boiler was first made, and these conditions, on account of the small size of the boilers, could be taken care of, but it is about time now that they changed it.

This letter is written as a forewarning to all since these explosions are becoming more and more frequent, also with the wish to help the point at issue in the locomotive today.

WM. H. WOOD,
Mechanical and Constructing Engineer.
Media, Pa.

Derailment.

EDITOR:

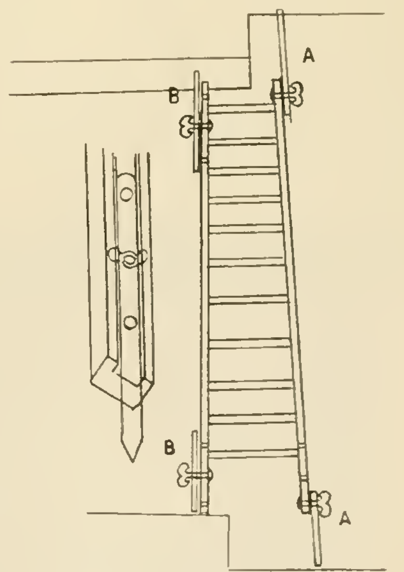
Some time ago the locomotive I am now running had to be sent to a shop for general repairs; which she received. She is a Consolidation, weighs about 65 tons, 15-ft. rigid wheel base, 16 degree curves in track. Having no turntable or Y we have to back up one way over our run of 20 miles. I had her back tires set to the proper gage and lateral motion given to the back driving boxes to assist her in passing around the stiff curves in the track. But she would mount the rail on the left side when backing up. Did so on straight track. She never did this before. I have been running her over this same track for ten years. I found the cause and removed it. What was the cause? Open to anyone who wishes to answer through the columns of RAILWAY & LOCOMOTIVE ENGINEERING. If anyone is interested enough to know the cause and the cure I will give it in a later number of this journal. I have been running a locomotive for 30 years and this is my first experience of this kind.

FRED NIHOOF.
White Sulphur Springs, W. Va.

Machine Shop Ladder.

Editor:

Enclosed is a drawing of a little device which I think would prove of some value in a machine shop. As you are well aware, it is frequently a hard matter to place a ladder exactly where it is required owing to some obstruction being in the way and thereby preventing the two ends or feet of the ladder from resting on the ground exactly level with each other. To overcome a difficulty of this kind you will note from the drawing that the ladder has extension legs, and the ladder is placed in a difficult position where neither end of the ladder can rest on a level plane. The extension legs, you will also note, would be easy of construction. All that would be required would be bore some small holes in the top and bottom side bearings of the ladder, and to attach metal extensions thereto, and arrange means to tighten the slidable portions with thumb screws. A. A. shows the added portions extended. B. B. shows the legs in normal positions. The number of holes and consequent amount of extension could be arranged as desired.



MACHINE SHOP LADDER.

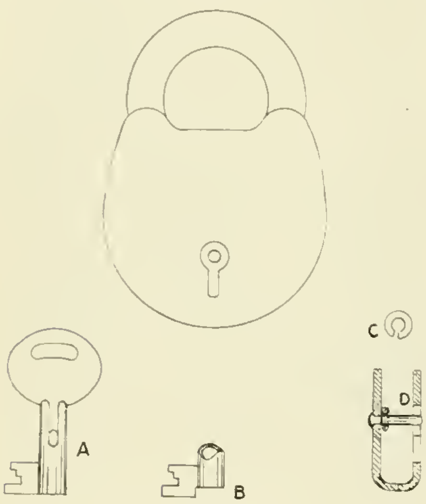
Paterson, N. J. T. J. PRATT.

Improved Padlock.

Editor:

In a large Canadian railway repair shop here nearly all of the employees have a padlock of their own for various purposes and reasons sufficiently good to

themselves. Some are direct and some indirect, and many kinds are used especially on tool boxes. In spite of their variety, however, some of the employees on the night shift delve deeper than the lock maker, and supply themselves with keys of a dozen different kinds of design, and seem to have no great difficulty in making a private inspection of the interior of the tool boxes. In order to put a stop to these questionable transactions, we cut a small piece off the key, as shown at Fig. B, in the enclosed sketch, and made from steel wire an open ring, Fig. C, and placed the ring inside of the lock



PADLOCK DEVICE.

on the key guide pin shown at Fig. D The lock may be readily opened by the owner of the key from which the small piece has been cut, but when the midnight prowlers come along with their false set of keys, they find that their right hands have lost their cunning, and as they say, they are up against it, and they are compelled to turn their mechanical ingenuity to some other more honorable occupation.

J. G. Koppel.

Montreal, Canada.

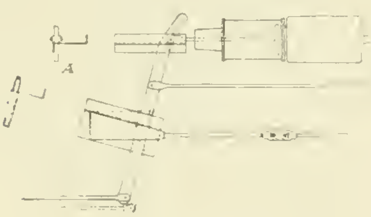


FIG. 1.

A Light and Loaded Car Brake Adjuster.

Editor:

A simple method of obtaining increased braking power is shown in the accompanying drawings. By moving the cylinder lever longitudinally by means of a wedge located centrally between the brake rods attached to the cylinder lever. The brake lever is suitably lengthened at its connection with the push rod, and a diagonal slot is made so that the lever may be adjusted to any desired point, according to load of car.

The diagonal slot is designed to ensure

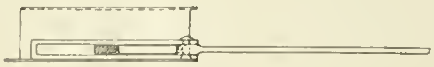


FIG. 2.

sure the push rod remaining at the light position when not otherwise adjusted. It also takes care of the increased piston travel when the longer leverage is in use. The cylinder lever carriers are rigidly bolted to body of car and are of sufficient strength to withstand the lateral strains. The carrier next the push rod will also keep the push rod in direct line with the cylinder, this preventing any distortion of the brake piston and leather.

An automatic light and loaded car brake adjustment is much desired, but the difficulties presented are such that the expense and maintenance of such a device would seem to preclude its adoption, and would seriously add to the already complicated conditions of train operation. The method shown is simple in construction, and would not involve much expense.

T. F. Bellhouse.

Sacramento, Cal.

Freezing of Air Pump Steam Cylinders.

Editor:

Inasmuch as I have never had an air pump steam cylinder freeze and burst that I have drained, and throughout even the mildest winter, we have a great many exposed to frost on account of the lack of house room, it may interest many of your readers to know my method of preventing the freezing in the cylinder. The first thing is to remove the drain cock from the cylinder, and do not depend upon it being open. If it be a reversible passage pump take the plugs out of the side that is not in use. There is a large pocket there that will invariably be found to be full of water. This is the only difference between the direct and the reverse cylinder passage in regard to the reversible freezing up.

If these plugs are removed when the pump is in the shop for repairs and graphite and oil is used when replacing them, their removal for draining will be an easy job. Another remedy that pays well for the little time that it takes to do the job is to take some heavy oil and waste and wrap the oil saturated waste around the piston rod that is about to be exposed to the weather, and also wrap between the stuffing box nuts, as they will soon rust and cut out packing for some time if pump is put in service again. If your able correspondent, Mr. Everly, foreman of air brake repairs on the Baltimore & Ohio, can get the pumps on his air brake system cared for in this way, I am sure he will find that it will be a complete prevention against freezing. The method that I have briefly described has been found to be very successful here, and we have had some fierce weather here this last winter.

Wm. J. Jones,
Roundhouse Air Brake Machinist,
Chicago, Burlington & Quincy Railroad.
Beardstown, Ill.

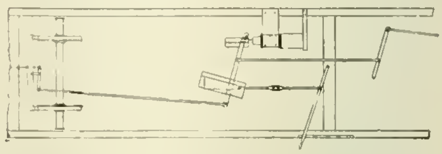


FIG. 3.

Vitznau-Rigi Railway.

By Hugh G. Boutell.

On the Lake of Lucerne, about an hour's boat ride from the city of that name is situated the Rigi, one of the most beautiful mountains in Switzerland. While in that country of snow-capped peaks the Rigi must be called a "lesser peak," since it does not reach the land of eternal snow, nevertheless, owing to its surroundings, it probably gives the tourist one of the finest mountain panoramas in the world. The Rigi is a real mountain, the kind we picture in our imaginations; on all sides it rises abruptly from the plane of the lake, and when we reach the summit there is nothing more above us, it really is the top.

The peak has been a favorite one with tourists for years, though the ascent by foot of a mountain 5,905 ft. high is, of course, no easy task, especially if one is out of training. It was but natural, therefore, that the first rack railroad in Switzerland should be built from Vitznau, on the shore of Lake Lucerne, to Rigi Kulm.

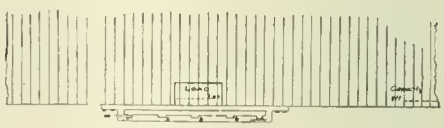


FIG. 4.

The road was opened to the public on May 21, 1871, though it had been in operation for one year previous to that time transporting materials used in the construction work. It is standard gage, built in the most substantial manner, with rock ballast and steel ties. The road operates on the Riggenbach system; that is, between the two running rails is placed a central rack rail, and engaging the teeth of this rack rail is a pinion on the locomotive. Thus the engine can ascend grades away beyond those which can be negotiated on an ordinary line. The rack rail resembles a water trough, such as one sees on many of our Eastern roads, with pins stuck through from side to side near the top. Of course, the rack

rail is very heavy, however. The original motive power of the road consisted

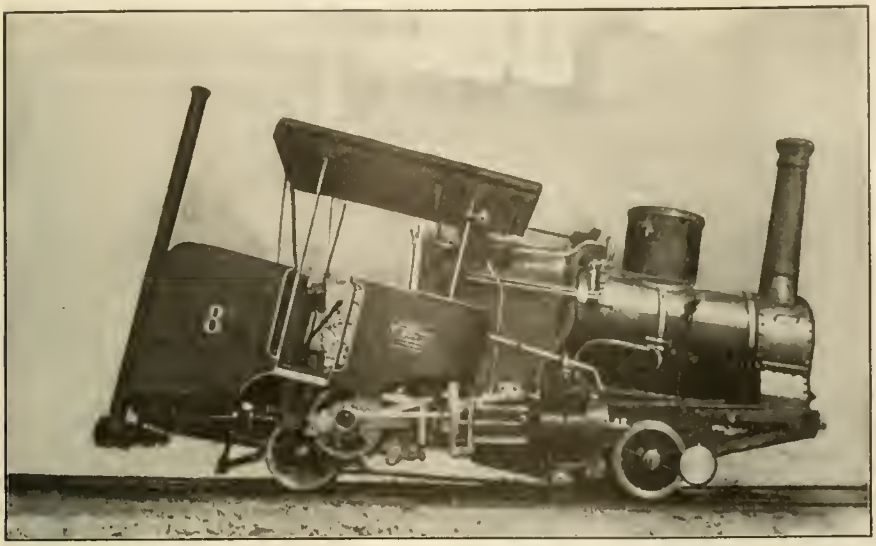


FIG. 1.

of three locomotives having vertical boilers and cylinders parallel with the

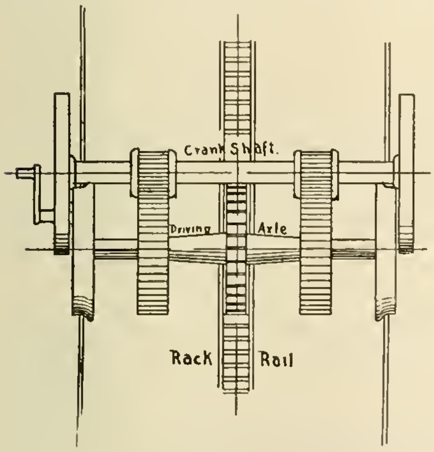


FIG. 3.

rails, but these boilers proved unsatisfactory and were removed and horizontal boilers were substituted. At present there are two standard classes of engines in use on the road, as shown in Figs. 1 and 2. The older engines, the running gear of which was built in the railway shops, at Olten, in 1871, have Belpaire boilers and four wheels. The driving pinion is carried on the center of the rear axle and on each side of it are two smaller gear wheels engaging pinions on the driving shaft, which carries the crank pins. The general arrangement is shown in the sketch, Fig. 3.

An engineer will readily understand that on a road having maximum grades of 25 per cent., as the Rigi Railway has, must so design its engines that when ascending this grade the water in the boiler doesn't entirely uncover the front ends of the upper tubes. To prevent this the boilers are set so as to be level on a 12 per cent. grade and the roof and crown sheets of the firebox are sloped downward towards the rear so that they will not be burned when the engine is on the parts where there is a level track.

The old engines have Allen link motion outside the crank pins.

As shown in Fig. 2 the boilers are of the round-topped style and the running gear is somewhat different from that of the older engines, but the idea is the same. On these engines the Walschaerts' valve gear is used. The engines have both steam and hand brakes on the axles and driving shaft and water brakes on the cylinders. The exhaust pipe of the water brake is shown at the back of the tank in the picture of No. 8, and just ahead of the cab of No. 12.

These locomotives are finished in beautiful style, with polished caps to the smoke stacks, brass fittings, etc.

Owing to the very even torque delivered by the geared cylinders the engines give an absolutely steady motion, differing very much from machines constructed on the Abt system, like the Pike's Peak Railway, where the connecting rods work directly on the drivers.

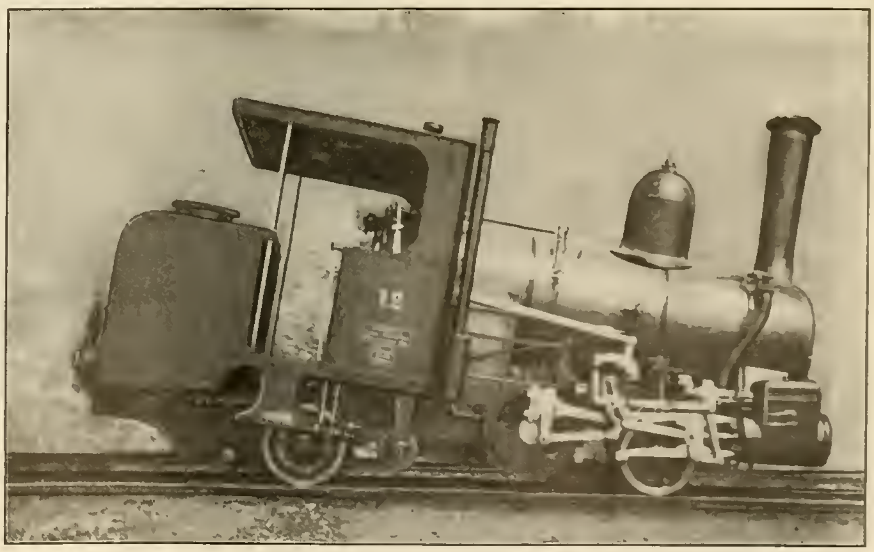


FIG. 2.

The engines push their cars, one large passenger car being sufficient load for an engine, and as the sharp exhaust of the little engines echoes among the ravines you would think the train was making thirty miles an hour, whereas in reality it is only moving at a comfortable walk.

The shops of the road are located at Vitznau, the lower terminus of the road, and are in charge of Mr. Hans Braun, the superintendent of motive power, who is an extremely able man. He has spent some time in the United States and is very familiar with our practice. He has introduced a number of kinks into his shops which would be of benefit to many railway men. One thing I noticed was an arrangement of movable rails at the turn table, shown in Fig. 4, which does away with the frogs ordinarily used.

Any engineer visiting Switzerland should not fail to make a trip over this interesting railway.

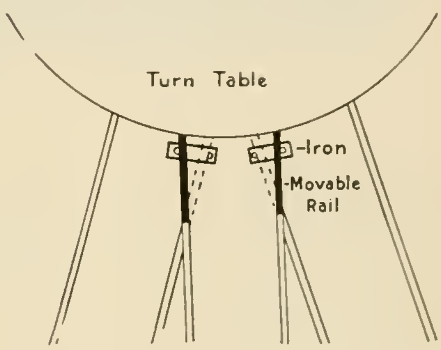


FIG. 4.

The Listowel & Ballybunion Railway.

By J. B. Williams.

A few months back some pictures were given in Railway & Locomotive Engineering of a mono-railway, constructed on the Lartigue system, in Algeria. We now

give illustrations of an interesting little railway constructed on this system in the southwest of Ireland, which has been operated for both passenger and goods traffic for close on quarter of a century.

The Listowel & Ballybunion Railway connects Listowel, a market town and station on the Great Southern & Western Railway line from Limerick to Tralee and Killarney, with Ballybunion, a small but growing village on the borders of the Atlantic Ocean, having a remarkable beach, and much frequented in the summer as a seaside resort. The railway is about 10 miles long.

As is well known, the main feature of the Lartigue system is that it is a single elevated rail raised about 3 ft. 3 in. above the level of the ground. The double-headed rails are of steel, weighing 28 lbs. to the yard and 31 ft. long. The rails are supported on "A" shaped trestles of angle-iron, connected at their lower ends to a steel sleeper 3 ft. 3 in. long, and spaced the same distance apart, except at the joints, where this distance is decreased one-half. The angle-irons at the top of the supports are bent vertically, so as to fit under the rail head, and against the web, a ¾-in. bolt connecting the three parts. The trestles have stiffening ties, and these also carry the lateral guide rails, about 18 inches below the carrying rails, against which the guide wheels of the rolling stock bear. In places the land is of a boggy nature, and here it has been necessary to support the line on longitudinal sleepers. The railway follows the contour of the ground, hence there is very little of it level, although the worst gradient is 1 in 50.

Although this is claimed to be a cheap form of construction for a light railway, the difficulties of sidings, cross-places, etc., cannot be over estimated. At the termini at Listowel and Ballybunion, the tracks radiate from turn-tables, as shown in the illustration. As may be imagined, all the making-up of the trains has to be done piece-meal.

The peculiar construction of the line also necessitates the employment of very extraordinary locomotives and rolling stock. The engines each have two small boilers, connected by a common steam pipe, the working pressure being 150 lbs. per sq. in. The boilers have brass tubes and copper fireboxes, the heating surface of each boiler being 71¾ sq. ft. and the fire grate area 2½ sq. ft. Each engine has two cylinders, 7 in. diameter by 12 in. stroke, driving the middle one of three coupled driving wheels, 24 in. diameter, located between the boilers. The tender can also be used for traction, being driven by two cylinders, 5 in. diameter, with a stroke of 7 in. It is carried on two 24-in. wheels. The engine can be operated from either side and the air brake is fitted.

TRAIN ARRIVING AT BALLYBUNION STATION.

The rolling stock is also carried on a single row of wheels, the carriages being built with the lower part in two sections, between which the wheels are placed, just about level with the passengers' heads. The noise, when running, as may be imagined, is deafening, while the oscillation, in a fore and aft direction, is so bad that the Westinghouse brake couplings cannot be connected.

Of course derailments are practically impossible, but a few years back, on the night of Listowel races, some festive sportsmen placed baulks of timber between the trestles, with the result that an empty train returning from Ballybunion was crumpled up by the obstruction in an amazing manner, but luckily there was no loss of life.

It is evident that when one division of a carriage is fully occupied, any more intending passengers have to make their way to the opposite side of the train to obtain their seats, so that they have to get over or under the rail; a rather inconvenient proceeding. Special vehicles with steps to enable the rails to be crossed are therefore provided on each train and are much appreciated by the passengers.

Another very serious objection to the mono-rail is the trouble of highway crossings. The familiar level crossing is impracticable, so that the road has to be raised to the level of the rail, or the line is lowered to the level of the road, and an awkward and very inconvenient drawbridge has to be provided in either case.

TURNING AN ENGINE FOR SWITCHING PURPOSES.

Amongst the advantages of the Lartigue system are cheapness in construction of the line, and especially the bridges and viaducts, and further, curves of only 60 ft. radius can be traversed with ease. Telegraph poles can also be dispensed with, as the wires can be laid inside the trestles.

Old Time Railroad Reminiscences.

By S. J. Kidder.

On the Sunday morning alluded to in the previous part of these reminiscences, we got ready for the road. The make up of the crew was a motley one. For a fireman I had a sectionman, a school boy, a son of a section foreman was head brakeman, the yard master filled the position of conductor, and a lot of men from the gravel pit and picked up about town were taken along to load the wood.

In those days the engineer was not given a copy of train orders to retain, the usual practice being for the conductor to read such orders to the engineer, then place them in his own pocket. Before leaving Thayer the order as read to me was: "Run wild to Woodburn and return." We proceeded to that town, loaded our train and upon receiving a signal from the rear I pulled out for Thayer.

Reaching Osceola, 10 miles away, the operator handed me a telegram from the conductor to the effect that he had got left, so we set out the train, got running orders and returned to Woodburn with the engine for him.

The conductor who, by the way, had been uptown when we departed passed the whole thing off as a good joke on himself then on the following morning informed the roadmaster that I had purposely left him and also run to Osceola without running orders, the latter of which was true, as the order he had read to me before leaving Thayer did not contain the words "and return." Here was the opportunity the road master had been looking for and upon meeting me at dinner that noon said: "Well, I got you now where I want you! I got you discharged! fired! thrown out of the road"!! He was not especially nimble with a pen, but that afternoon got busy with a letter to the general superintendent, intent on getting me "thrown out of the road." I, too, wrote a letter to the same officer, fully explaining the whole affair and to make sure that my letter would reach its destination before that of the roadmaster I flagged the express as it came into the station that night, giving the letter to the conductor with a request that he deliver it to the general superintendent upon his arrival in Burlington and which he promised to do.

Much to the road master's surprise, and not a little to my own, no order came to suspend or discharge me and finding his little game blocked, how, he never knew, he gradually came around and in time we became good friends. It is quite foreign to the usual order of things for an engineer to both run a locomotive and conduct a banking business but such proved to be my experience during a sojourn of some eight months in the little village of Thayer. The town was only three or four years old, could boast of two general stores and a tin shop, and, being in the center of a good farming community, had a considerable trade. The greatest drawback to the place from a business standpoint was the absence of currency, very little money being in circulation, the result of which was that most of the business between the merchants and their country customers was by barter, dry goods, groceries, etc., being exchanged for farm products.

The gravel pit was being operated by a contractor, John Brady, and as accommodations for the hundred or more men in his employ could not be supplied by the town, he had erected large shanties just outside, where, under the supervision of the pit superintendent, all the men were housed and boarded.

Upon the approach of hot weather the temperature at the base of the 65 feet, almost perpendicular, gravel bank became so oppressive that the men began quitting, their places being taken by others, and upon giving up work were handed a due bill upon which, in addition to what was coming to them, was a notation giving the amount of board bill due.

Some of these men I had come to know quite well, and one day shortly after the first hot spell set in, while sitting in the cab saw one of them heading toward town who, in reply to my question, stated he had quit and was going to see if one of the merchants would cash his time check. He was gone perhaps an hour when he returned and climbing into the cab started to tell his experiences with the merchants.

Said he, "I went to all of them and none had any money. The last one I saw told me there is only one man in town who did have, and that was the young fellow running the 13, so I came down to see you." He then went on to explain that the contractor paid off for one month only on the 15th of the following one. If he quit the 1st he would have to wait fifteen days for his money; if he worked to the 15th a month would elapse before he could collect his stipend, and as the superintendent charged one dollar a day for the man's board when not working, he wished to get away before all that was due him was absorbed in a board bill.

I was quite interested in listening to his recital of how an employer manages to get the use of his employees money for a considerable time and finally cashed his check.

This, of course, was promptly advertised in the pit, and the following day two others came on a similar mission, receiving cash for their checks. About this time it occurred to me that it would be well to ascertain where I was coming out in these transactions, and from that time until the next pay day I took no more checks. Simultaneous with pay day came the contractor, and from a good-sized satchel, well filled with greenbacks, he proceeded to pay off his men. In the depot telegraph office later in the day I presented the three checks which the contractor promptly cashed, remarking, as he handed me the money, "buy all of them you want to, you can have your money every fifteenth." I took his advice and for the following several months the cab of the old 13 in addition to being used for ordinary purposes was utilized for a banking house as well. The three time checks already purchased had been taken at face value, but as no well-conducted banking house can be successfully carried on without some profit in the transactions, I promptly adopted the usual practice of "shaving," or in more modern parlance, discounting the checks, from which a balance in my favor of from seventy to ninety dollars a month was derived. The reminiscences above recited cover the time I ran the 13, and it is left to the readers of Railway and Locomotive Engineering to draw their own conclusions whether or not that number proved a lucky one to me.

Improved Engine Tender.

An improvement on engine tenders has been perfected and patented by Mr. William Heinig, Fitchburg, Mass. The object of the invention is the provision of a coal receptacle or pocket which automatically operates when released to bring that portion of the pocket having the greatest amount of coal nearest to the engine, so that the fireman does not have to handle the coal a second time to get the same into the firebox. The device consists of a circular pocket plate on an ordinary tender and resting on a bearing plate having a ball or raceway formed therein adapted to receive anti-friction balls. At suitable intervals around the receptacle there are sixteen openings closed by doors which are slidably mounted in guide bars. The receptacle is so constructed and mounted that it is lower in front, and rotates automatically when released, and the weight of the coal has the effect of bringing to the front that portion having the largest amount of coal, so that the coal is always conveniently in position to avoid the necessity of walking to the rear of the bin as the coal is consumed.

One of the drawbacks to manual training in day schools is the tendency of teachers and others to magnify its importance and to circulate the belief that manual training is sufficient to supply the skilled mechanics that formerly were acquired by apprenticeship to trades. A boy who has received sound manual training is in a good position to enter as an apprentice, but when he aspires to enter upon regular work through the school training he is preparing the way for bitter disappointment.

New Locomotives for the Chicago & Western Indiana

The recent marked improvement in heavy locomotives for switching and heavy transfer service is one of the outstanding features in locomotive construction of the present time.

The Chicago & Western Indiana R. R has recently received ten locomotives from the Baldwin Locomotive Works. These engines are intended for this kind of work and are designed to traverse curves of 230 feet radius. Five are of the Mogul (2-6-0) type and five of the (0-8-0) type. All are equipped with superheaters, brick arches and Baker valve gear.

The Mogul locomotives are among the heaviest of their type thus far constructed, as they weigh 193,200 pounds and carry 166,000 pounds on driving wheels. This type of locomotive, long popular in general freight service, has on many roads been superseded by other types having higher relative steaming capacity. A study of the present design, however, shows it to be admirably adapted to the service requirements, as the typical ratios are quite as favorable as those found in many locomotives handling through freight traffic over long divisions of trunk line railways. The total equivalent heating surface, making the usual allowance for the superheater, is 3,021 square feet, or 224 square feet for each cubic foot of cylinder volume. The ratio of adhesion is 4.48, and the percentage of total weight carried on the driving wheels is 86. The quotient obtained by dividing the tractive force (in pounds) by the total equivalent heating surface (in square feet) is 11.9, which indicates a higher relative steaming capacity than is found in many successful Consolidation engines. The tractive force exerted is 36,000 pounds.

The superheater is of the Schmidt top-header type, with 32 elements. The piston valves are 14 inches in diameter and are set with a lead of ¼ in. Forged vanadium steel is used for the driving axles. The constructive details call for no special comment. Cast steel is liberally used for frame braces and other structural parts.

MOGUL TYPE OF LOCOMOTIVE FOR THE CHICAGO & WESTERN INDIANA RAILROAD.

SWITCHING TYPE OF LOCOMOTIVE FOR THE CHICAGO & WESTERN INDIANA RAILROAD.

The general dimensions are as follows:

Gauge—4 ft. 8½ ins.

Cylinders—23 x 28 ins.

Boiler—Type, straight; material, steel; diameter, 76¾ ins.; thickness of sheets, ¾ ins.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 108 ins.; width, 69¼ ins.

Water Space—Front, 4½ ins.; sides, 4 ins.; backs, 4 ins.

Tubes—Diameter, 5⅜ and 2 ins.; material, steel; number, 5⅜ ins., 32; 2 ins., 205; length, 13 ft. 7 ins.

Heating Surface—Fire box, 185 sq. ft.; tubes, 2,056 sq. ft.; total, 2,262 sq. ft.; grate area, 52 sq. ft.

Driving Wheels—Diameter, outside, 63 ins.; center, 56 ins.; journals, 9½ x 13 ins.

Engine Truck Wheels—Diameter, 33 ins.; journals, 6½ x 12 ins.

Wheel Base—Driving, 14 ft. 9 ins.; rigid, 14 ft. 9 ins.; total engine, 23 ft. 10 ins.; total engine and tender, 56 ft. 10½ ins.

Weight—On driving wheels, 166,000 lbs.; on truck, 27,200 lbs.; total engine, 193,200 lbs.; total engine and tender, about 330,000 lbs.

Tender—Tank capacity, 7,400 gals.; fuel capacity, 11 tons; service, freight.

Superheating surface, 506 sq. ft.

The switching locomotives are of unusual power and exert a tractive force amounting to 48,800 pounds, the ratio of adhesion being 4.35. The design is similar in many respects to that of the Moguls, and interchangeable details are used where practicable. In the switchers, the equalization system divides between the second and third pairs of driving wheels, and the engine is cross-equalized in front. The suspension link in the center line is pinned to a large steel casting which braces the frames just back of the cylinders, and serves as a fulcrum for the driving brake-shaft.

The tenders used with both classes carry 7,400 gallons of water and 11 tons of coal. The frames are composed of 10-inch and 13-inch channels, and the trucks have cast-steel side frames.

Their general dimensions are as follows:

Gauge—4 ft. 8½ ins.; cylinders, 24 x 30 ins.; valves, balanced piston.

Boiler—Type, wagon top; material, steel; diameter, 74½ ins.; thickness of sheets, 11/16 and ¾ ins.; working pressure, 190 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 120 ins.; width, 60¼ ins.

Water Space—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes—Diameter, 5⅜ and 2 ins.; material, steel; number, 5⅜ ins., 32; 2 ins., 214; length, 14 ft. 9½ ins.

Heating Surface—Fire box, 188 sq. ft.; tubes, 2,261 sq. ft.; total, 2,472 sq. ft.; grate area, 50.2 sq. ft.

Driving Wheels—Diameter, outside, 57 ins.; center, 50 ins.; journals, main, 10 x 13 ins.; others, 9½ x 13 ins.

Wheel Base—Driving, 15 ft. 6 ins.; rigid, 15 ft. 6 ins.; total engine, 15 ft 6 ins.; total engine and tender, 51 ft. 1 in.

Weight—On driving wheels, 212,400 lbs.; total engine, 212,400 lbs.; total engine and tender, about 350,000 lbs.

Tender—Tank capacity, 7,400 gals.; fuel capacity, 11 tons; service, switching.

Superheating surface, 554 sq. ft.

New Shops on the Canadian Pacific.

An important announcement was made by the Canadian Pacific Railway that Calgary had been selected as the site for the new western shops. These shops, while not so extensive as the Angus shops at Montreal, will be among the largest on the American continent. There will be at the start 20 large buildings, covering an area of 120 acres, and erected at a cost of over $5,000,000. Since the announcement many large Canadian industrial firms have announced their intention of locating branch offices here. The big manufacturing firms which have decided to locate in Calgary will employ about 10,000 men. This will mean an immediate increase of many thousands in population.

In Saskatchewan.

At the beginning of the year the Canadian Pacific Railway had 414 miles of main line and 1,660 miles of branch lines, making a total of 2,074 miles in the province; the Canadian Northern Railway had 400.67 miles of main line and 1,653.93 miles of branch lines, or a total of 2,054.6 miles; and the Grand Trunk Pacific Railway had 415 miles of main line and 267.67 miles of branch lines, or a total of 682.67 miles. These figures give a total for the whole province of 4,811.52 miles, made up of 1,230.47 miles of main lines and 3,581.05 miles of branch lines. It appears that there was a shortage of labor throughout the whole of the working season; unsettled weather also interfered a good deal with progress.

Interborough to Sell Direct to Employes.

The Interborough Rapid Transit Company, of New York, on February 15, opened up the first of its supply stores for the benefit of its employes. This is one of six stores the company intends to open following a vote taken among the employes of the power houses and car houses to get their opinion of the project. Meats, vegetables, groceries and other supplies will be sold at little above cost. The second store was opened on March 1 at Fiftieth street and Seventh avenue. Coupons which will pass as currency at the stores will be sold to employees from the various offices and terminals.

Notes on Grinding.

In last month's *Canadian Machinery* there are some valuable notes on grinding. Among others it states that "loading" is the condition in which some of the ground-off material adheres to the face of the wheel, and "glazing" is the condition in which the cutting grains and their bond are on an even plane on the wheel surface. In grinding copper, "finish" is always proportional to the fineness of the wheel.

The color of a grinding wheel does not affect the cutting quality or the life; the cause is the difference in color of the bond used. The use of compound in grinding improves the cutting and prolongs the life of the wheel, and, to get true grinding economy, there must be co-operation between the grinding and turning departments. Often the grinding machine is not given due credit for the saving in turning, made possible only by the grinding methods. As a rule, the greatest economy is obtained by the combination of grinding with very rough turning.

By simply changing the speed of either the wheel or the work, failure is often turned into success, and transferring a wheel, after it has worn down to a small diameter, from a large machine to a small one is a good plan. Always true the wheel at the speed at which it is to be used. Long life in a wheel, secured by sacrificing rapid production, is not economy.

Seasoning of Wood.

An investigation made by one of our leading railroads some time ago regarding the natural seasoning of woods concluded that oak began to season naturally in March and April; that pine lost moisture within a fortnight after its first exposure; that ash and poplar began the loss in April and elm immediately on being exposed in January. With the exception of elm the seasoning of most woods ends with the summer months. All woods take up slight moisture during wet weather in fall and winter; pine of small dimensions, like inch flooring, will absorb moisture during the wet months. One season of average weather is generally sufficient to season wood for purposes of construction.

African Teak.

So indestructible is African teakwood that vessels built of it have withstood hard ocean going service for over one hundred years. This wood is one of the most remarkable lines of timber employed in the industries, being noted for its great weight, hardness and durability, its weight varying from 42 to 52 pounds per cubic foot. It works easily, but owing to the large quantity of silex which it contains, the tools require to be very hard and even then are subject to rapid wear. It contains an oil which prevents screws driven into it from rusting.

Standardization in the engineering sense means the elimination of the unnecessary.

Catechism of Railroad Operation

Questions and Answers.
Second Series.
(*Contnued from page* 95.)

Q. 1. How would you test for a leaky rotary valve in the No. 6 E. T. automatic brake valve?

A. Make a 15-pound reduction, lap the brake valve and close the cut-out cock in brake pipe, then note the action of the gauge, if the black hand on the No. 1 gauge moves up faster than the black hand on the No. 2 gauge it indicates a leak of main drum pressure past the gasket 18 into chamber d. While a leaky rotary valve will be indicated by a raise on the black hand of the No. 2 gauge. Also a blow at the brake pipe exhaust. Still another method of testing for a leaky rotary is to place the brake valve in service position until all air has been exhausted from chamber D and brake pipe. If the air still continues to flow from the direct exhaust port at the back of the valve it indicates a leaky gasket 18, permitting main drum air to flow into chamber D. While a blow at the brake pipe exhaust would indicate a leaky rotary valve. The cut-out cock should also be turned while making this test.

K. 2. How would you test for a leaky independent rotary valve?

A. A leaky rotary valve in the independent brake valve will permit air to escape from the exhaust of the automatic brake valve while in running position, or may cause a blow at the independent exhaust. This might also allow reduced pressure to pass through the application cylinder pipe to the application cylinder and set the brakes, when the automatic or independent brake valve was placed in lap position. To test, lap the automatic brake valve and note whether the brake applies. In the event of the brake cylinder pressure raising to the adjustment of the reducing valve it indicates that the pressure is coming from the independent brake valve. By disconnecting the pipes and noting which direction the air is flowing from, the trouble can easily be located.

Q. 3. How would you test for a leaky application valve in the distributing valve?

A. A leaky application valve will permit main drum air to blow from the exhaust of the distributing valve in release position. However, if the quick action cap is being used a leaky emergency valve could also permit brake pipe air to pass up through port M into the brake cylinder space and thence out to the exhaust. To locate which is at fault close the cut-out cock in the distributing valve supply pipe. If the blow then stops it is the fault of the application slide valve. While if it continues it is a leaky emergency valve. A leaky application valve will also be indicated by the red hand on the No. 2 gauge raising above the pressure in the application cylinder, forcing the application piston to release position causing a slight blow at the exhaust when the red hand will again move up.

Q. 4. How would you test for a leaky exhaust valve in the application part of the distributing valve?

A. Set the brake with either automatic or independent if there is a blow at the brake cylinder exhaust of the distributing valve, when the brake is applied it denotes a leaky exhaust valve.

Q. 5. How would you make a test to determine if the application piston is leaking?

A. Close the stop cock in the distributing valve supply pipe and set the brake with the independent brake valve, then open the drip cock under the equalizing portion of the distributing valve. This drip cock is tapped into port M, which leads up to the back of the application piston, therefore any leakage past the packing leather will blow out through the drip cock.

Q. 6. How can a test be made to determine a leaky equalizing slide valve?

A. It must be borne in mind that the equalizing slide valve controls the flow of air to the distributing valve release pipe, and pressure chamber air is constantly on top of the equalizing slide valve; therefore, any leakage past this valve will cause a blow at the exhaust of the automatic brake valve when both valves are in running position. In the event of either brake valve being placed in lap position the leakage past this valve will then build up a pressure in the application chamber and cylinder, causing the engine brake to apply. To test this valve apply the brakes with the automatic brake valve then close the cut-out cock under the automatic brake valve and return the handle to running position. A leak of pressure chamber air past the equalizing slide valve to the distributing valve release pipe will blow out through the exhaust of the automatic brake valve, thereby reducing the pressure chamber causing the brake pipe pressure to force the equalizing piston and slide valve to release position releasing the brake. Still another method, and possibly a plainer way, would be to disconnect the distributing valve release pipe and note if air blew out from the distributing valve end which would indicate leaky slide valve.

Q. 7. What effect would a leaky graduating valve have on the engine brakes?

A. A leaky graduating valve will only effect the engine brakes when a partial automatic application has been made and the equalizing piston and graduating valve has been moved to lap position. In this position if the graduating valve is leaking it will permit pressure chamber air to flow into the application chamber and cylinder raising the brake cylinder pressure, and might have the effect of releasing the brake after a partial service application. In the event of this engine being the second engine of a doubleheader.

Q. 8. Why will not a leaky graduating valve release the brake on a single engine?

A. This is due to the fact that while the brakes are applied on the single engine the brake valve is in lap position; therefore, the distributing valve release pipe is closed even though the equalizing piston and slide valve do move to release position the application cylinder and chamber pressure cannot pass out through the exhaust, therefore the brake will not release.

Q. 9. How would you test for a leak from pressure chamber to the atmosphere, such as a leaky drain plug?

A. Make a reduction with the automatic brake valve, then close the cut-out cock under the brake valve; next place the brake valve handle in running position, when the leak from pressure chamber will reduce the pressure on the slide valve side of the equalizing piston; brake pipe pressure will then force the piston and slide valve to release position, when application cylinder and chamber air will flow out through the distributing valve release pipe by way of the independent brake valve through the automatic brake valve and release the brake.

Q. 10. What would be the effect if the application cylinder and distributing valve release pipe were crossed on the number 6 E T?

A. The brakes could be applied and released with either brake valve, but in the event of an automatic application the brakes could not be released with the independent. This is due to the fact that if these pipes were crossed the application cylinder pipe would then be controlled by the equalizing slide valve; therefore, if the equalizing slide valve

was out in a setting position this pipe would be blanked and the application cylinder and chamber air would not be exhausted out through the independent brake valve. Also, in the event of double-heading, when leading engine applies the brakes the air would flow from the application cylinder out through the independent and automatic brake valve, and the brakes would not apply unless the automatic brake valve or independent was placed in lap position.

Q. 11. What would be the indications of a brake cylinder leak on the red hand of the No. 2 gauge?

A. With a full service application the red hand on the No. 2 gauge should move up and register about 50 pounds. In the event of a brake cylinder leak it is quite possible that this hand will fall sometimes to 45 pounds, when the pressure in the application cylinder will force the application piston and slide valve over to the right, opening up communication from the main reservoir to the brake cylinder, causing the red hand to again move up. As a matter of fact, the red hand should fluctuate up and down between 45 and 50. This is one of the maintaining features of this equipment.

Q. 12. How would you make a test of the safety valve without interfering with the brakes on the train?

A. First close the cut-out cock under the automatic brake valve, then place the valve in emergency position and adjust the safety valve at 68 pounds by the red hand on the No. 2 gauge. In this position main drum pressure will flow through the maintaining feature of the automatic brake valve through the application cylinder pipe directly to the application cylinder.

Q. 13. What pressure does the safety valve connect with direct, and how does the safety valve control the brake cylinder pressure?

A. The safety valve connects at all times excepting in automatic lap with the application cylinder, and the pressure in the application cylinder governs the pressure that will be obtained in the brake cylinder.

Q. 14. What effect would it have on the operation of the brakes on the engine and tender if the distributing valve release pipe, that is, the lower pipe on the left side of the distributing valve was broken?

A. This would cause the engine and tender brake to release when the automatic brake valve was placed in holding or release position, and would also release the brakes on the engine and tender after an independent application. If the independent brake valve was placed on lap position, it would also prevent the brakes from being applied with the independent brake valve in slow service position. They could, however, be applied by placing the independent brake valve in quick application position, although air would be constantly flowing out through the broken pipe.

Q. 15. What should be done in the event of a distributing valve release pipe breaking?

A. If this pipe breaks, leave it alone, as it is not necessary to plug it. In the event, however, of it being necessary to hold the engine brakes applied while releasing the train brakes, the independent brake valve can be held in application position; this will hold the engine brakes applied, although air will be discharging out through the broken pipe; the larger opening through the independent brake valve will hold the application cylinder pressure at about 40 pounds.

Q. 16. How can main reservoir air leak into the application chamber, and what effect would it have on the operation of the brakes?

A. Main reservoir air can leak into the application chamber from the passageway where the air enters from the distributing valve supply pipe due to a defective gasket between the divided reservoir and the operative parts of the distributing valve. This leak will cause blow at the exhaust of the automatic brake valve when both brake valves were in running position, and would also raise the pressure in the application chamber and cylinder up to the adjustment of the safety valve when an application was made with either brake valve. This would also increase the brake cylinder pressure to the same amount as that in the application cylinder.

Q. 17. What effect would water have in the application chamber on the operation of the brakes?

A. In the event of water being permitted to accumulate in the application chamber it would have the effect of reducing the space; therefore, the pressure chamber and application chamber would equalize at a higher pressure. It would also have the effect of freezing up in cold weather, causing the distributing valve to become inoperative.

Q. 18. What effect would water in the pressure chamber have on the operation of the brakes?

A. This would reduce the volume of air in the pressure chamber; therefore, would cause the pressure to equalize with the application chamber and cylinder at a lower pressure.

Educating Both the Head and the Hands.

The real problem is to determine whether to educate the head or the hands, or both. Both have been overdone in the past. To overcome natural narrow-mindedness it is believed best to educate both. Theory and practice go well together. If we theorize incorrectly the practice will not agree; hence the reason for educating and balancing the head.

High-Speed Steel.

In connection with cutting steels, a profound sensation was aroused throughout the steel world when, at the Paris Exhibition in 1900, the Bethlehem Steel Co., of the United States, showed turning tools made under the alleged patent of Messrs. Taylor and White, cutting very mild steel at a speed which rendered the nose of the tool red hot. It was obvious that in these tools the thermal stability of the hardenite had been raised to perhaps 600 degs. C. What the enterprising firm had really done was to show that this type of steel was capable of retaining its cutting edge at a much higher temperature than most engineers and metallurgists had realized. For this demonstration every credit was due to the Bethlehem Co. Sheffield steel-makers, realizing future possibilities, made from the year 1900 and onward a series of experimental researches, which eventually gave to engineers that astonishing material known as high-speed steel, in which the thermal stability of the fortified hardenite was raised to about 700 degs. C.

Wrought Iron.

There is an increasing tendency in recent construction to go back to the greater use of wrought iron as compared with steel. This reversion is already on a considerable scale. In Pennsylvania alone there are now fifty-three iron mills in existence, and probably over two hundred in the United States. The prevalence of rail breakages, owing to piping and segregation in steel, could not possibly obtain in wrought iron. Lamination troubles were frequent enough in the old days of iron rails rolled from piles, but if rails had again to be rolled for iron, piling would be an obsolete institution. It is well known that because of the excessive corrosion which British railway companies have discovered in mild steel, they have now largely come to the conclusion that with regard to the rolling stock they must revert to iron, sacrificing superior strength to other considerations. There was also a marked preference shown in the demands from the Colonies for galvanized sheets of iron instead of steel, owing to the greatly lessened liability of the former to corrosion.

The Erie Railroad people are devoting much attention to utilizing scrap for repair purposes. One of the latest moves in this direction is the converting of old flue tubes into locomotive pilots. Pilots made of this material have been proved to be stronger than the ordinary wooden pilots and they have a particularly neat appearance. The cost of construction is low and leads to considerable saving on parts that call for much repairing.

Questions Answered

LUBRICATION.

A. S., Bucyrus, Ohio, writes: We have in use here engines equipped with Schmidt Superheaters, with cylinders measuring 25 ins. by 30 ins. Steam pressure 100 pounds. For several months after these engines were put in service we were allowed 7 pints of high-grade oil for 115 miles. The oil was specially intended for use on superheater engines. Now we are allowed two and a quarter pints for the same distance. This is on heavy freight service, and from this supply of oil we have also to lubricate the air pump. The engines are equipped with fine feed lubricators, but under instructions we do not use the cylinder feeds, and are instructed to adjust feeds to three drops per minute to each valve. The pistons and valve stems become so dry that frequently the packing is found melted and all run into a mass together. We find a considerable increase in the amount of coal necessary in the handling of trains since the reduction of the coal supply. Please advise if this supply of oil should be considered sufficient to properly lubricate the valves and cylinders. A.—According to the latest data on the subject of lubricating superheated engines, the amount of oil should be sufficient, two pints being usually allowed for 100 miles. Much, however, depends on the conditions, the quality of water as well as the nature of the grades greatly affecting the lubrication. It is noticed in districts where mineral deposits obtain in water, the wear of piston rings and other packing is rapid and much more lubrication is required than the amount referred to. Heavy grades also greatly affect the lubrication. A recent case on the Louisville & Nashville was called to our attention. On a steep grade of eight or ten miles the piston and valve packing frequently melted, and a clever engineer experimented by shutting off the throttle for two or three revolutions with the result that the danger point was safely passed. This could be accounted for only on the ground that the lubricant was not reaching the heated spots, and the momentary shutting off of the steam allowed it to reach those parts previously affected. It should be further noted that in drifting, if the throttle is entirely shut and no steam allowed into the cylinders the atmosphere rushing into the vacuum created by the movement of the pistons has the effect of carbonizing the lubricant, and the effect is about the same as if an equal quantity of emery were injected into the valve chests and cylinders. In drifting therefore it has been found that running with a "cracked" throttle, that is, with the throttle slightly open, is an advantage, and whatever small loss there may be by the misuse of steam is more than made up by a continued saving of the lubricant. It is also good practice to allow a small amount of the lubricant to reach the pistons independent of the supply admitted to the steam chests. Mr. Spellen's contribution on the subject in another part of this issue contains much useful information on the subject, but, as we already stated, there are no exact rules to be guided by any more than there is on the life of flues or other parts of the locomotive that are subjected to varying conditions. If a number of intelligent engineers agree that the amount of lubrication allowed is too small it may safely be relied upon that they are right.

TENSILE STRENGTH AND WORKING PRESSURE.

R. D. Hattiesley, Miss., asks: How is the tensile strength of boiler sheets one-half inch in thickness obtained, and how is the working pressure obtained in a cylindrical boiler, the first course of which is 59 inches in diameter, the second course 60 inches, and the third course 61 inches, lap joint, and double row of rivets or longitudinal seam, outside row of rivets 5 inches pitch, inside row 2¼ inches?—A. In obtaining the tensile strength of sheets for boiler construction the rule is that from each plate rolled there shall be taken two test pieces, one for tensile test and one for bending test. The piece for tensile test shall be taken from the side of the plate at about one-third of its length from the top of the plate. The skin shall not be removed, and shall be at least 16 inches in length, and from 1½ inches to 3½ inches in width. The piece shall be marked with light prick punches one inch apart, spaced so as to give eight inches in length. The plate must show when tested a tensile strength of not lower than 50,000 pounds per square inch. Tests for elongation vary according to the thickness of the plate. There are also quenching and bending tests whereby the plate is heated to a cherry red and quenched in water at a temperature of 82 degs., and bent to a curve not greater than one and a half times the thickness of the plate, without cracks or flaws.

The pressure for any dimension of boilers must be ascertained by the following rule. Multiply one-sixth of the lowest tensile strength of the plates in the cylindrical shell by the thickness, expressed in inches or parts of an inch, and divide by the radius or half diameter, also expressed in inches, and the result will be the pressure allowable per square inch of surface for single riveting, to which 20 per cent. should be added for double riveting.

As an illustration, suppose the tensile strength of the steel is 60,000 pounds per square inch, this amount divided by six would be 10,000, which multiplied by one-half,—the thickness of the sheet,—would be 5,000, which divided by the radius of the cylinder of the boiler, say 30, would leave 166⅔, to which add twenty per cent. on account of the double riveting would give a safe working pressure of 200 pounds.

WEAR ON MAIN LEFT BOXES AND BRASSES.

A. B. S., Boone, Ia., asks: Why do the left main box and brass of a ten-wheel engine pound and wear first and most? A.—Because of the unbalanced condition of an ordinary two-cylindered locomotive. As is well known, the right hand main crank is set 90 degs. ahead of the left hand crank, and if the thrust is followed it will be observed that the left hand boxes and brasses become a kind of fulcrum to a greater extent than the right side. This, of course, is presuming that the locomotive is working in the forward motion. If running backwards the opposite effect would be observed, and the right side would wear more rapidly. Again, if the locomotive had three cylinders and the cranks were set at 120 degs. apart, the thrusts of the pistons would be equally balanced, and the wear would be equal. This peculiarity is not confined to ten-wheel locomotives, but may be observed to a more or less degree on all two-cylindered locomotives having their cranks set at right angles.

TRACTIVE POWER OF A LOCOMOTIVE.

F. S. G., St. Louis, Mo., writes: In computing the tractive power of a locomotive the amount is usually given in pounds. What is the rule in regard to the relation between the number of pounds of tractive effort and the number of tons that the locomotive will haul? And what allowance is made for curves and grades? A. Many experiments have shown that in starting a locomotive on a level track it will take about 16 pounds of tractive force to move one ton. After acquiring a speed between 5 and 10 miles per hour about 6 pounds of tractive effort will keep the train in motion. As the speed increases the amount of tractive force necessary increases until at a velocity exceeding 110 miles an hour almost the entire tractive effort will be necessary to keep the engine and tender alone in motion. In regard to curves, the construction of the road-bed, speed, length of train, weight of cars, and other conditions, make it impossible to give a rule approaching exactness. The resistance owing to curves varies from .7 to 1.0 pound per ton per degree of curvature, the lower figure for large cars and the higher figure for smaller capacity cars. In regard to grades, if the grade is expressed in feet per hundred, the added resistance in pounds per ton will be about 20 pounds per ton for each per cent. of grade.

BROKEN SUPPLY PIPE.

A. B., Youngstown, O., Writes:—Can an engine equipped with the "E T" brake be handled on a descending grade with the air brake, if the distributing supply pipe is broken off? A. Yes. Some months ago we explained how this could be done if the distributing valve has a quick action cap, that is, by stopping the leak from the broken pipe and carrying the brake valve handles in application position and moving to release position with the automatic valve to permit brake pipe pressure to enter the brake cylinders through the quick action cylinder cap and the release would be accomplished with the independent valve.

At the present time, however, we believe that the simpler and more positive way to handle the engine brake is to stop the leak from the broken pipe, remove the emergency slide valve and the cylinder check valve from the quick action cap and use the automatic brake valve in release position to apply the brake and in emergency position to withdraw the brake pipe and brake cylinder pressure, to release the brake.

If the distributing valve has the plain cylinder cap, remove the cap and cut an opening in the cylinder cap gasket between the brake pipe and the brake cylinder ports, replace the cap and gasket and use the automatic brake valve as previously mentioned.

You will note that the independent valve is not used in this operation, hence the brake could be handled in this manner even if the application cylinder and release pipes were also broken off.

USE OF BRAKE VALVE.

R. M. B., Bowling Green, Fla., writes: Can I use the "S 6" independent brake valve of the Number 6 E. T. locomotive brake by itself on a locomotive equipped with the straight air brake without any of the other equipment? If so, how can I do it? A.—No. The independent brake valve was designed to operate the application piston of the distributing valve and the port openings are proportioned to the size of the application cylinder of the distributing valve and the application chamber of the divided reservoir, hence the volume of compressed air that can pass through the brake valve in a specified length of time is limited to the size of port openings, which are too small to admit the necessary volume of compressed air directly to and exhaust it from the brake cylinders in the longest permissible time for an application and a release of brakes.

BROKEN AI PUMP.

C. S. C., Moncton, N. B., writes:—What would be the explanation for the breaking in two of the centerpiece of a 9½-in. air pump when it was working properly and all bracket bolts said to be tight, and are many such cases known?—A. The old style 9½-in. air pump centerpieces were frequently broken because of rough handling in changing pumps on the locomotive, and due to a structural weakness which is entirely eliminated in the present style of centerpiece.

While broken centerpieces from fair usage are now practically unknown, it is possible for any cylinder or centerpiece to fail from defective casting, corrosion, crystallization, or explosion. We have seen frozen up air pumps which broke their heads, centerpieces, and the bolts holding them to the bracket, and we have seen air cylinder explosions from pouring engine oil in the strainer of an overheated pump which caused the pump to break its centerpiece and pipe connections and fall to the ground.

AIR PUMP DEFECT.

J. H., Philipsburg, N. J., writes: In overhauling an 11-in. air pump, the main valve bushing, the reversing valve and its bushing were renewed, and the pump would not run. A new head was applied and the overhauled head was put on the new pump and both pumps worked. Why would not the overhauled head work on the overhauled pump? A.—No doubt because of a combination of steam cylinder packing ring and small end main valve packing ring leakage and possibly main slide valve leakage. When the repaired head, with small end main valve packing rings that were improperly fitted or too loose in the piston grooves, was applied to the new pump, the leakage past the rings or possibly past the slide valves, was insufficient to prevent the operation of the pump, and when the new head was applied to the overhauled pump the steam cylinder packing ring leakage in itself could not prevent the operation of the new head.

BRAKE VALVE TROUBLE.

J. B., Peoria, Ill., writes: I am running an engine with the combined AI-SWB equipment, and if coupled up to a train, the gauge shows 70 and 90 lbs., but with the lone engine the hands go up to about 100 lbs., have had feed valve and brake valve cleaned, but without helping the trouble. Can you let me know where to look for the trouble? (b) On same engine have a duplex pump governor, the top connection of the small one is made to the brake pipe under the brake valve cut-out cock, and the lower one to the main reservoir port in the brake valve, if the brake valve is on lap main reservoir pressure runs up to 100 lbs., and when placed in running position it drops back to 90 lbs. Kindly explain how it is regulated? (c) What is the cause of the black hand of the gauge not falling when the valve handle is on lap and there is a small leak in the brake pipe? A.—Your trouble is evidently due to a leak through the rotary valve of the brake valve or through the lower body gasket, the fact that a brake pipe leak will not cause the hand on the gage to drop when the handle is on lap, eliminates the feed valve and gasket from the disorder. The reason that brake pipe pressure does not increase when coupled to a train is because the leakage from the brake pipe is greater than the leakage through the brake valve, while with the light engine the conditon is reversed and the brake pipe pressure increases above the adjustment of the feed valve.

The governor top you refer to is the SF type, which provides for an automatic regulation of main reservoir pressure. The diaphragm valve of the excess pressure head is held to its seat by a spring with 20 lbs. tension and whatever brake pipe pressure that may be used, hence if 70 lbs. brake pipe pressure, the governor will not stop the pump until 90 lbs. accumulates in the main reservoir, and main reservoir pressure will remain 20 lbs. in excess of the brake pipe regardless of the brake pipe pressure until the adjustment of the maximum top is reached.

On lap position the movement of the brake valve handle cuts the air pressure off from the lower pipe and renders the excess pressure top inoperative, and the maximum top must stop the pump, and in dropping back to running position the excess pressure head again comes into operation, and the gauge hand drops back to 90. The top is regulated by screwing down the adjusting nut to obtain more pressure and slacking off to obtain less, however the handle must be in running position, and the maximum top must not be set so low as to interfere at this time. You will understand that this top is adjusted according to the position of the black hand and not by the fixed position of the red hand.

It is interesting to note that bills have been passed in half a dozen of the smaller states calling for locomotive headlights of 1,500 unreflected candle power to enable the engineer to distinguish a human form at a distance of 800 feet. The States of New Jersey, New York, Connecticut, Minnesota, New Mexico, North Dakota, Virginia, Wyoming, Iowa, Massachusetts, Pennsylvania, Rhode Island, Vermont, Nevada, New Hampshire, Michigan, West Virginia, Nebraska, Missouri, and Delaware advise that they have no law covering this subject.

Don't expect to find in strikes the greatest industrial waste; it will be found in the wrong employment of men. Out of ten men probably only one fills the job that he ought to be filling; and of ten jobs probably only one is filled by the man who ought to be engaged for it.

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Getting On in Railway Life.

Some time ago the writer received a letter from a bright young machinist complaining about the unsatisfactory prospect there is for a good machinist, who has striven with admitted success to become a first-class workman. This young man is a good representative of his class and complains of a grievance, which applies to a multitude of other young men, who suffer from the condition that superior positions are far less numerous than the humble ones. He is acknowledged to be a first-class machinist, and although he has been less than ten years at the trade, has been for three years a gang boss, receiving equal to the highest pay of the shop. This is the top of the ladder for a workman, but this man is not satisfied with it and bewails the meager prospect there is for advancement, and remarks that he might have done much better in some other line of business. About this we are very doubtful.

There is an unfortunate tendency among mechanics to look with envy upon the dapper clerk, who never needs to soil his hands, and can always go about with a starched shirt on; but the lot of the mechanic is by far the more fortunate of the two. The clerk who is receiving $70 or so a month ten years after beginning the business is fortunate beyond the average of his class. If anything happens to make the clerk lose his situation, he is almost certain to experience difficulty in finding another position. The supply of genteely dressed clerks being chronically away beyond the demand, those who are in the business have habitually to put up with acts of petty tyranny and injustice that no high-spirited mechanic would for one day endure. In the course of the struggle of a somewhat chequered life, the writer has worked as a clerk and as a mechanic in different places and periods, and he cannot conceive of any working life more exempt from the petty vexations and annoyances that take the sunshine out of employment than that enjoyed by a good mechanic.

So far as "getting on" is concerned, which means becoming more than an ordinary workman or common clerk, the great mass of workers continue doing the prevailing run of work all their lives because it employs most hands, and it is generally the possession of some special capability or attainment that recommends a workman for promotion to the position of foreman or a clerk to the head of an office. Men are frequently advanced to take charge of work who have no real fitness for the position; but those who are responsible for injudicious selections are generally the ultimate sufferers. When a mechanic becomes noted in a shop as an expert workman, he considers that he ought to be selected for promotion in preference to others who have acquired less artisan skill. This is a mistake, and heads of departments have endured many expensive lessons to teach them the truth. A first-class workman who takes great pride in finishing every job as if it were a work of art, is likely to be a poor foreman, because he cannot endure to see anything passed on as finished if it is not as well done as he would do it himself. In most shops, more especially railway shops, the mass of work must pass as being well enough for its purpose, when it is far from being perfect for other purposes. It is often a waste of labor to put finish on work that is no better from extra polish or finish, yet this is the mistake the close working mechanic is constantly inclined to fall into. Of two men, one a first-class mechanic with a passion for having work done in the best possible style, the other a commonplace workman with keen perceptions concerning the utility of work, the latter will make the better foreman every time.

There is, however, something more than knowledge of the shop operations and good judgment as to what sort of work is best for certain jobs needed, to make a first-class foreman. A man is not fit for being a foreman of an up-to-date shop, unless he has some knowledge of applied mechanics, of mechanical calculations and of drawing. The young machinist whose letter suggested this article, acknowledged that he knows nothing of drawing except that he can work to one, and he knows little or nothing of the mechanical calculations necessary in figuring the speed of tools and shafting, in estimating the power of screws or hydraulic pumps, in measuring by angles, or many other things that it is the shop foreman's duty to provide data for. This man who does not think his abilities and attainments are receiving proper recognition, does not conceive it was necessary that he should acquire knowledge of things that a lathe or vise hand is not called upon to perform.

The man who takes no pains or devotes no labor to instructing himself on the technical knowledge connected with his business, is not justly entitled to rise above the grade of a workman. There are young and old men connected with nearly all machine shops who have read and studied the literature and technicalities of their business, while others have devoted their leisure hours to amusement. The studious mechanic is the man who generally moves upwards, for he has the acquirements that make him more useful as a foreman than other mechanics who may be more skilful in common shop work.

Every improvement in machinery tends to call for increase of technical knowledge on the part of those who direct the repairs, and every year there is going to be less likelihood of a mechanic who is not familiar with the science of his business being selected as a foreman, no matter how skilful he may be in doing routine work. The young man advanced to be foreman is on the direct road to become the head of his department. To get on the plain road for attaining this distinction, a mechanic must devote his leisure hours outside of the shop to the acquirement of knowledge, for knowledge is the old-fashioned power that sends people soaring.

Safety First.

The earnestness with which the subject of an increased degree of safety on American railroads is being entered into is one of the most encouraging signs of the times among railway men. The good cause has been taken up with a degree of earnestness this year in a way in which it was never taken up before, and already the results are of the most gratifying kind. The methods of education are bet-

ter and the methods of inspection are more thorough, and what is better still, there is a degree of earnestness among officials and workingmen that is rapidly becoming an integral part of the life of railroad men. Indeed, the importance of the movement cannot be overestimated. As long as a single accident occurs which by just reasoning can be attributed to a defect of equipment or a laxity in the best methods of operation, just so long will there be need of a continued effort at betterment in the direction of increased safety.

As is shown from the occasional reports, which are necessarily brief, that are presented in our pages, it will be noted that meetings are being held at nearly all of the principal railroad centers. These meetings are being largely attended, and the interchange of opinions embodying individual experiences are of the most interesting kind. Much real gain is made where men can meet face to face, and untrammeled discussion rarely fails in producing that condition of mentality where they can see eye to eye.

The problem is deserving of the best efforts of all right thinking men. The statistics of railroad disasters have almost been a blot on our civilization, and while we naturally take a pride and derive a satisfaction from the great work of American railroads, a work which has no parallel in the history of the world, we are confident that the time has come when the work can be carried on with a greater degree of safety not only to those who are engaged in the hazardous occupations incident to railroad work, but to all who may come in contact with the transportation system which has opened up a new continent.

Expansion of Gases.

There are certain phenomena connected with the action of gases which are not well understood by persons whose occupation keeps them constantly dealing with gas in the form of air and illuminants. A few notes concerning the action of gases may be of practical value to our readers.

When a gas is subjected to an increase of pressure, the volume of the gas becomes less; and when the pressure is withdrawn, the gas immediately expands again, and occupies exactly the same volume which it did before the pressure was increased. Solid and liquid bodies cannot be compressed in the same way. On this account gases are known as compressible fluids and liquids as incompressible fluids.

There used to be ignorance and difference of opinion among scientists concerning the behavior of gases under pressure. The investigation of this phenomenon was industriously pursued by Robert Boyle, an Irish nobleman born in 1627, with the result that he established what is known as Boyle's Law, which states that the volume occupied by any gas is inversely proportional to the pressure to which it is subjected.

At the time Boyle was investigating the behavior of gases another scientist, Edme Mariotte, was working on the same problem in France. Both physicists arrived at the same conclusion concerning the behavior of gases under pressure, and the details are often spoken of in this country as Mariotte's Law.

French Boiler Experiments.

A French engineer who made extended experiments of the evaporation through boiler plates found that immediately after the fire, with natural draft, the average evaporation was 30 pounds of water per hour to each square foot of heating surface, and with forced draft this evaporation rose to 50 pounds, but that there was risk of plate burning when scale was present.

. In a second series of experiments the temperature of the plates was measured by fusible plugs, and it was found that clean plates 7/16 in. thick never reached a high temperature even when the fire was forced. When scale-covered sheets were covered with grease, what is known as the spheroidal state of water was readily produced. That is, instead of evaporating, the water formed into globules that jumped about on the sheets.

Statistics of Railways and Population.

It is interesting to observe in the reports of the Bureau of Railway Economics, which was established by railways of the United States for the scientific study of transportation problems, the reports of some of the comparisons of service of agriculture and the railways in relation to the growth of population. For example, the production of 25,000,000 more bushels of wheat in 1910 than in 1900 might seem a gratifying increase. But an addition of sixteen million to the population reduced the per capita supply in 1910 to eighty-six per cent. of what it was in 1900. And so also should facilities of the railways be measured. There was an increase of 25 per cent. in the miles of line, 29 per cent in the miles of main track, and 36 per cent. in the miles of all tracks between 1900 and 1910. But if the comparison be made in relation to the population we find that in 1900 there were 2.53 miles of line for each one thousand inhabitants, and in 1910 2.62 miles of line, an increase in proportion to population of only 3.4 per cent. Miles of main track on the same basis increased 6.4 per cent., and the miles of all tracks 12.3 per cent.

In the matter of track and equipment of the railways for each 10,000 inhabitants, it is also interesting to observe that the increase in miles of track increased from 34.05 miles in 1900 to 38.25 miles in 1910, while the number of locomotives also increased from 4.96 to 6.41 during the same period. The highest rate of increase in the statistics is shown in the tractive power of the locomotives, the average in 1902 being 10,112 pounds, while in 1910 it had amounted to 17,275 pounds, or an increase in tractive power of nearly 71 per cent. The number of freight cars had also increased from 1900 to 1910 about 29 per cent., and their capacity in tons nearly 50 per cent., while the passenger cars per thousand of the population had increased 12 per cent.

Favors Civility to Passengers.

Among the internal improvements effected on railways of late years, has been an increase of civility towards the people who find it necessary to travel on railway trains. Trainmen, as a rule, are civil and obliging, but there are still a great many exceptions, and people who travel much can readily pick out lines of transportation where they are likely to see and hear things that are discreditable to the officials who are in charge of men who have not learned that civility is due to the humblest person using the cars. Men who are permitted to treat with habitual discourtesy the humbler portion of the traveling public not only inflict injury on the company they work for, but they sow seeds of hatred that brings antagonism to all railway interests.

Anti-railway sentiment has been industriously cultivated in many districts by the habitual incivility and want of accommodating sentiment among certain railway officials and rudeness on the part of trainmen sows broadcast the seed that produces a similar harvest. The emigrants and the second-class passengers, who are often treated by trainmen and by some officials as if they had no right that demanded respect, good feeling or humane treatment may not be able to influence legislation now, but they are likely in the near future to have potent power on juries. The law of self-preservation alone, if no higher consideration can reach them, ought to convince railway managers that civility is a good-paying investment.

What has struck the writer while traveling on roads where civility and courtesy were at a discount was that the division superintendent ought to ride occasionally in day cars and even in smokers.

Early Injectors.

We do not believe that any apparatus ever introduced for mechanical purposes has excited so much curiosity among mechanics as the boiler feeding injector. In Europe when that injector first appeared mechanics here familiar with the extra power obtained by the action of the vacuum and the condenser, and the more inquiring minds associated the ac-

tion of Giffard's injector as being analogous to the steam engine vacuum. One of the mysterious visitations the writer shared in as a young apprentice was stealing into an engine house at dead of night to help two engineers to take an injector apart to search for the cause of its mysterious action. The quest was vain. Nothing was found.

The boiler feeding injector was invented by Henri Giffard, a French physicist who was much interested in balloons. He had one idea of many steam engines to propel balloons and the injector was invented as being a particularly light boiler feeding appliance. A patent was granted in Great Britain on the injector in 1858.

As used for boiler feeding the injector was a decided novelty, but the principle of the steam jet on which the injector works had been applied for raising water long before Giffard's time. In the great range of experimental work carried on for a century before Newcomen applied a piston to a cylinder, numerous attempts had been made to perform mechanical work by means of fire in which the vacuum and the steam jet figured prominently.

The Giffard injector had no sooner been invented than the locomotive boiler was looked upon as particularly suitable to its operations. It began to appear on British locomotives about 1859 and met with decided opposition from the men running the engines, who objected to using for the important function of boiler feeding an apparatus they did not understand. The story is told of an agent for an injector company having tried in vain to induce the driver of a certain engine to use the injector resorted to the trick of removing both lower pump check valves. The injector prevented an engine failure and received its first meed of credit.

The manufacture of the Giffard injector was first introduced into the United States in 1860 by William Sellers & Co., of Philadelphia. Much difficulty was experienced in inducing master mechanics to try the instrument upon their locomotives. As a prominent master mechanic of the time expressed it, "boiler feeding is no joke and burned crown sheets make a tragedy." The first step for progress was made by Matthias Baldwin, who placed an injector upon a locomotive built for the Clarksville & Louisville Railroad, followed by one being applied to a Detroit & Milwaukee engine. About the end of 1860 the Pennsylvania Railroad began applying the injector, which assured its general introduction, but its progress into popularity was very slow. The conservative tendencies of the American locomotive engineer were powerfully illustrated in the way he opposed the injector. It was a common practice for engineers to refuse to take out an engine unless it was equipped with one pump. By degrees it came about that the solitary pump was neglected so much as to be unworkable when needed, dependance having been made upon the injector. That gradually led to the pumps being taken off all locomotives and a good riddance it was.

New York Central Nautical School.

The New York Central management have been so well satisfied with the results obtained from their Apprentice Schools that they are likely to inaugurate a similar system to the Marine department of the company. Mr. Reynold Fay, superintendent of operation in the Marine department of the New York Central, has been earnestly urging that two courses of instruction be given to the Nautical School, an engineering and an above deck course.

Talking on the subject Mr. Fay said: "Why shouldn't the boys who study engineering at the Nautical School devote their studying to that and the kindred subjects, such as electrical work and steamfitting, and let the lads who want to stay up on deck specialize in just the studies that every ship's officer should know?

We entirely agree with Mr. Fay's views and have no doubt that much good would come if they would be carried out, both the students and the public being certain to receive benefit.

The Railway Tool Room

The organization of the Railway Tool Makers' Association and other influences are bringing to the front the importance of tool makers and tool room managers. Attempts have been made at various times to do justice to these high-class workmen but without much success, and we are glad to see that they are now coming to their own.

Several years' ago Mr. G. W. Hinkens, the noted foreman blacksmith presented a paper on the Tool Room Manager to a railway club in which he made several points in favor of giving the tool room and its occupants greater consideration. He held that the tool room man should be a mechanical expert, with intimate and accurate knowledge about steel that would enable him to tell at once the cause of breakage of the tools in use. When a tool room man does not know steel thoroughly he is at the mercy of the toolsmith whose carelessness and shortcomings are readily covered up by plausible stories.

When the toolsmith finds that the tool room man understands his business, the former will do his work with greater care, resulting in benefit all round. The ordinary toolsmith is a conscientious person who tries to do his work properly, but sometimes a different kind of man gets hold of the job. In that case an efficient tool room man saves no end of annoyance and loss.

The tool room man and the toolsmith should work in harmony, co-operating together to produce satisfactory results for the benefit of the employers; there should be no attempt at mastery one over the other; their interests being identical their personal feelings should respond accordingly. No attempts at dictation should be made, common sense holding the balance. The first requisite for successful co-operation is that both these men should understand their business, for ignorance on one side and pretention on the other bring deplorable results.

The tool room in the average shop should be general in its scope. A wise foreman draws knowledge and information from every source, whenever it is to be found. The humblest helper can sometimes give useful hints. The average workman uses his hands; the mechanic uses his brains to save the workman's hands.

Selection of Steel.

There is frequently much loss experienced with steel tools for want of good judgment being exercised in the selection of the material. Taking up the question of selection of steel for tools, we find in general use three qualities and eight grades in each quality, making twenty-four varieties in all.

The quality varies with the price and is generally selected by the purchaser, while the grade of temper is selected by the dealer, according to the size and shape of the bar. The selection is regulated by experience as to common use, and any departure from this will require a variation in the grade or quality to produce the best results.

In using pneumatic hammers for chipping we had trouble with chisels breaking, which was cured by purchasing steel one grade lower in quality than that which we had been using. Again in making sectional flue expanders from two-inch round steel, and hardening in water, there was more or less trouble from breakage, which was overcome by using steel about three grades higher and hardening in oil without drawing the temper. To do this work properly, close habits of observation count highly towards success.

Getting On.

Mr. Ingalls who recently retired from the position of chairman of the Big Four company was a good authority on "getting on in the world." He maintained that there was little difference in the energy required to achieve success from what ends in failure. The difference is in the way the energy is utilized. Some men use concentration others diffuse. The diffuser never gets there.

The Baker Valve Gear.

At the last Traveling Engineers' Convention Mr. R. F. Darby of the Pilliod company speaking concerning failures of the valve gear he represented said, "It has often been said that the gear is very similar to the Walschaert. We get our driving forces that make the gear run in the same way that a Walschaert does. Part of it comes from eccentric crank and part of it from the cross-head. In that respect the two gears are alike. The combination lever of both the Baker gear and the Walschaert gear moves the valve the amount of the lap and the lead each way, that is, if you have an inch lap and a quarter-inch lead the combination lever is so proportioned that it moves the valve 2½ inches. The rest of the valve travel comes from the eccentric crank. Do not understand me to say that in five inches valve travel 2½ inches of it comes from the combination lever. We find that in a given valve travel, we will say, six inches, about 5¾ of it comes from the eccentric crank and about ¼ inch from the combination lever. That is, if we use a ¼-inch lead. In other words, the combination will add to the valve travel the amount of the lead.

With the Walschaert gear, of course, the eccentric crank connects on to the link. In the Baker gear it connects on to a mechanism that takes the place of the link and block. The cut-off in a Walschaert is controlled by the position of the link block, the raising and lowering of it. With a Baker gear it is the position of the reversing yoke. The reversing yoke is that piece to which the reach rod is connected. It stands up in the middle of the gear and throws over backward and forward; when it lies forward it is in forward motion and when it lies backward it is in backward motion. Half way it is neutral.

With that as a basis I will try to tell you something about possible breakdowns. We wish we never had any, but of course they will occur as long as valve gears are made, so we have to look out for them.

You might say breakdowns are divided into two parts. One that throws out the use of the eccentric rod; that is, any break so that you will have to disconnect the eccentric rod and do away with that part of the valve travel the second any break that throws out the use of the combination lever. In the first case the Baker gear still can use its combination lever and get a port opening for all cut-offs equal to the lead. It will be enough to help over a dead center. That is about all. The way we take care of a breakdown of this kind is by blocking what we term the bell crank. In case of any breakdown where you have to take off your eccentric rod you simply block the lower end of the bell crank in a vertical position. There are two holes provided in the frame for that purpose. I might add that I think we have put out a few gears without these holes.

The reason we did so was that we felt uncertain about the location of them and left it to our men to get it done in the railroad shop. We found that the railroads very often did not do it on account of the shop foreman wanting the engine out of the shop. So we started doing it ourselves, so that from now on they will be that way and they have been for some time past.

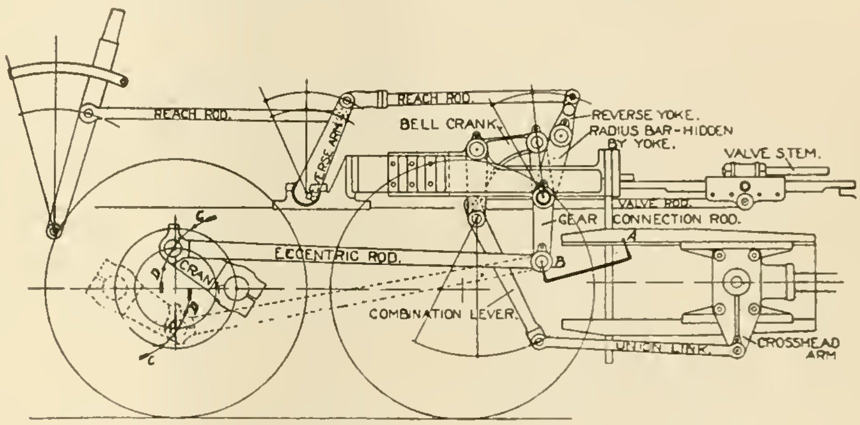
There is one thing I want to say about blocking in those holes. Do not use too small a bolt. The reason I say, do not get too small a bolt, is that if you do they are liable to be sheared off and the valve start to moving. We have had one or two failures in which case they have done all right. I do not believe we have had one where the bolts have sheared off; if we have, I have not heard of it. That one blocking will take care of a broken eccentric rod, eccentric crank or the internal parts in the frame, except the vertical arm of the bell crank. You then can go ahead with your lap and lead movement, on that side with a port equal to your lead.

In case a reach rod should break, of course you could still use your eccentric rod. You all know how you do this in a Stephenson motion or in a Walschaert motion. Block your link block at 50 per cent. or somewhere near that and work both gears. With our gear you can put a block of wood in under the reversing yoke. That gives the cut-off, but in doing this be sure to get it in there good and tight and then wire the yoke fast in that position and disconnect the short reach rod.

In case you should break a combination lever or the cross-head connection, or the link which connects the cross-head to the combination lever, it depends largely on the construction of the engine as to whether you will have to block the valve on the crippled side or not. You that have had any experience with a Walschaert gear know that in some cases you might be able to tie that combination lever, but in tying it you must get it straight up and down or else you shift the valve to one side or the other. In that case you would get all the steam on one end. The probability of being able to tie the combination lever is rather small and in most cases you would not be able to do it. If you cannot tie the combination lever you have to block the valve on that side, which of course throws that side clear out of commission.

In all our constructions where we use a valve stem cross-head we provide for that by putting a set screw in the cross-head. You that have some of our gears in use probably remember seeing that set screw there.

Some one raised the question of lubrication of cylinders in case of blocking valves. Of course, that would be taken care of the same as you take care of engines on your particular road. Some of you do one way and some another, and we do not want to interfere in any way with anything of that kind. Do it the same as you always do.



THE BAKER VALVE GEAR.

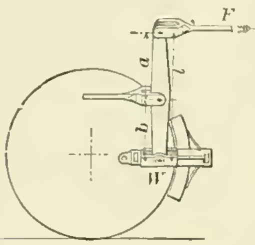
There is one point I would like to mention and that is the oiling system. There really are no oil cups on the gear, but an oil cavity. One man yesterday raised the question about three holes in our bell crank and said two were small and the other one was large. I discovered that he thought all three holes went through to the bearing. I would like to explain that the two small holes do go clear through to the bearing. The one big hole in the middle is simple like the top of the oil cup. If you put oil in that one big hole it covers the whole thing. The oil will gradually work over to the other two holes.

When an engineer first takes out one of these gears the one thing he must look at first is the oil holes. On the first gears we put out we had a little difficulty with one oil hole that is down on the inside of the frame, but we are taking care of that now by putting a brass pipe from the top of the frame right down to that bearing, so that he can reach it without any trouble at all.

Air Brake Department

Car Brake Leverage.

Those who are engaged in the inspection and repair work on air brakes, as a general rule, devote their attention and labors to brake apparatus that is used to pull the shoes against the wheels, and piston travel and pressure per square inch being correct, their work is considered as completed, and naturally a great many men employed in this line of work pay very little attention to leverage and the frictional effect of the brake shoe when it is pressed against the revolving wheel.



$$W = \frac{F \times a}{b}$$

$$F = \frac{W \times b}{a}$$

$$a = \frac{W \times b}{F} \text{ or } a = \frac{W \times l}{F + W}$$

$$b = \frac{F \times a}{W} \text{ or } b = \frac{F \times l}{F + W}$$

FULCRUM BETWEEN APPLIED AND DELIVERED FORCES.

While it is not absolutely necessary for inspectors and repairmen to learn every detailed part of air brake operation and braking effect, it is nevertheless of a decided advantage to know something of the forces in effect upon a revolving car wheel when a brake shoe is pressed against it, and it is not unreasonable to expect the repairmen to know what the brake leverage ratio is based upon and the general effect of applying levers of different proportion to those removed and replaced.

It is desired to deal briefly with this leverage problem; and, in the first place, a lever is a mechanical device, usually in the form of a rod or bar, hinged on a fixed point or fulcrum and is used to increase or decrease the effect of a force applied to it, and if we have a bar or lever, uniform as to size and weight throughout, and suspend it from its exact center, it will remain in a horizontal position. If two equal weights are placed at the extreme ends of the lever or equidistant from the point of suspension, the position of the lever, representing a pair of scales, will not be changed, but any change in weight or position will destroy the equilibrium and one end of the lever will overbalance the other with a force measured by weight and distance. The weight in this instance, and in all cases that have reference to car brake leverage, varies directly with the distance, as for instance, a 4-lb. weight 1 ft. from the point of suspension or fulcrum balances 4 lbs. 1 ft. from the center on the opposite end of the lever, or 2 lbs. 2 ft. away, or 1 lb. 4 ft. away from the center. It may be well to keep this homely illustration in mind, for, if this is true, it naturally follows that if 500 lbs. in weight or force was substituted for the 1-lb. weight 4 ft. from the center, 2,000 lbs. could be lifted or brought to a balance if attached to the point at which we have assumed the 4-lb. weight to be, which is 1 ft. from the center of the lever.

Another point is that if 500 lbs. is balancing 2,000 lbs., the weight or pull on the fulcrum or point of suspension is the sum total of both weights, or 2,500 lbs. plus the weight of the lever itself. Another important point to remember is that if the 1-lb. weight 4 ft. from the fulcrum lifts the 4-lb. weight 1 ft. from the fulcrum, on the opposite end of the lever, the 1-lb. weight must travel four times the distance traversed by the 4-lb. weight during the transaction, or, through the leverage of 4 to 1, the 1 lb. will balance 4 lbs., and if the 4-lb. weight moves 1 in. in distance, the 1-lb. weight must travel 4 ins., being four times the distance from the fulcrum.

There are three classes of levers, the class being determined by the position of the fulcrum or fixed point and the point at which the force is applied, and as a certain force is applied to the lever with a view of producing another force or transmitting the same force, whether it results in a greater or lesser force, the remaining point is always termed the fulcrum, and in designating the points of a lever such as referred to, the point at which 500 lbs. was applied is the "force applied" point where 2,000 lbs. was developed is the "weight to be lifted" and the remaining point at which the lever is suspended is the fulcrum.

A lever of the first class is one where the fulcrum is between the "force applied" and the "weight to be lifted," such as we have been dealing with.

A lever of the second class is one where the "weight to be lifted" is between the fulcrum and the "force applied" point.

A lever of the third class is one where "force applied" point is between the fulcrum and the "weight to be lifted."

To illustrate more clearly: If an engine or car is being moved with a "pinch bar" placed between the wheel and the rail, the bar is a lever of the first class as the fulcrum (point of bar on rail) is between the force applied and the weight to be lifted.

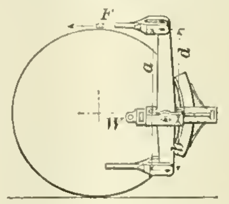
A bar being placed between the spokes of a driving wheel to lift, say, the back end of a main rod, is a lever of the second class, as the weight to be lifted is between the force applied and the fulcrum.

One end of the bar remaining under the main rod and a bucket being lifted at the other end of the rod by pulling up on the middle of the bar, transforms it to a lever of the third class, as the force applied is between the weight to be lifted and the fulcrum.

On passenger cars, piston and cylinder levers are of the first class, brake beam levers usually of the second class, and floating levers of the third class; and a lever of the third class is used to reduce the force applied to it, while a lever of the second class can only be used to increase the force applied to it, while a lever of the first class can be used to increase or decrease the force applied.

It will be remembered that shifting the point of force applied will sometimes change the class of lever, as in the case of a floating lever of the Hodge system; when the air brake is applied the lever is of the third class, but when the hand brake is applied the lever is one of the first class.

Quite an elaboration of formulas are used to determine weights lifted or forces exerted by levers of the different classes, one weight and two distances, or two weights and one distance being known, the calculation is very simple, and a rule



$$W = \frac{F \times a}{b}$$

$$F = \frac{W \times b}{a}$$

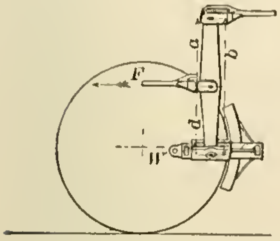
$$a = \frac{W \times b}{F} \text{ or } a = \frac{W \times d}{W - F}$$

$$b = \frac{F \times a}{W} \text{ or } b = \frac{F \times d}{W - F}$$

DELIVERED FORCE BETWEEN FULCRUM AND APPLIED FORCE.

that can be used to determine the force produced by any class of lever is: Measure from center to center of the pin holes, multiply the distance in inches from the force-applied point to the fulcrum by the force-applied in pounds, and divide the product by the distance in inches from the fulcrum to the point at which the weight is to be lifted. The result is always the actual number of pounds force transmitted by the lever, regardless of its class.

As the power developed by the brake cylinder is multiplied through this system of car brake levers and delivered to the brake beams to become effective on the shoes, it should be a very simple matter for the repairman to measure the distances and, knowing the power developed by the cylinder, calculate the number of pounds pressure delivered to each brake



$W = \frac{F \times a}{b}$

$F = \frac{W \times b}{a}$

$a = \frac{W \times b}{F}$ or $a = \frac{W \times d}{F - W}$

$b = \frac{F \times a}{W}$ or $b = \frac{F \times d}{F - W}$

APPLIED FORCE BETWEEN FULCRUM AND DELIVERED FORCE.

beam. One-half of this will be effective on each shoe, and if the car has four beams, the total braking force exerted is 4 times the pull on one beam.

It may also be of interest to observe that a single lever could be used to produce the necessary braking force for a car, but length of lever and position must be regarded in a practical application of a brake system; hence, a foundation brake gear is arranged to conform to the build of the car and, furthermore, a small brake cylinder could be made to deliver as much power as a large one usually does, but, as previously pointed out, force multiplied 10 times means 10 times the distance to travel; therefore, in order to provide ample shoe clearance, total leverage should not be more than 9 to 1; that is, the power of the cylinder multiplied 9 times to produce the proper shoe pressure. With this leverage ½-in. shoe clearance would require 4½ ins. piston travel to bring the shoes in contact with the wheel, and 1 in. clearance would require 9 ins. travel.

Shoe clearance can be found by dividing the piston travel by the total leverage employed, with 5 ins. piston travel and a leverage of 10 to 1, 5 ÷ 10 = .5 or ½-in. shoe clearance.

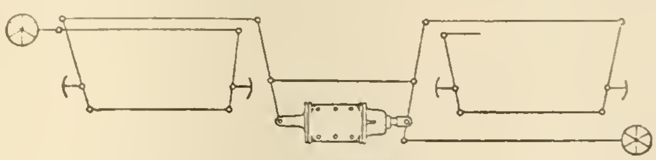
So far as the installation of a brake system on a car is considered, the force with which the shoe is drawn against the wheel is based upon the light weight of the car (weight at wheels on rail) and the maximum pressure developed by the brake cylinder. The pressure developed is termed the cylinder value. If a car is braked at 90 per cent. of its light weight, the total pressure on the brake shoes is 9/10 of the weight of the car when it is empty. Braked at 70 per cent. means 7/10 of the weight of the car. This is usually termed the braking power, and braking power divided by cylinder value gives the total leverage.

The dimensions of a live truck lever and a dead truck lever may not be the same, but their proportion, the spacing between the pin holes, must be the same to insure the same braking power on both beams.

While this braking power is based upon pounds pull and per cent. of weight taken with the car at rest, it is termed a nominal or unreal per cent. of braking power, as the forces acting on a car wheel in motion as a shoe is pressed against it, are not constant. The amount of brake shoe pressure that can be employed without incurring any liability of wheel sliding, depends principally upon the speed of wheel, energy stored in the wheel, the per cent of adhesion of the wheel to the rail, and the actual pull of the shoe tending to check the rotation of the wheel, the latter force being termed the "coefficient of friction."

Initiation and Propagation of Quick Action.

Generally, the air brake men throughout the country have for a long time been under the impression that the 1¼-inch brake pipe on the locomotive and tender was an advantage over the 1-inch pipe so far as ability to obtain quick action of the triple valve was concerned. Most everyone has had some erroneous ideas concerning the actual effect of what is termed pipe friction or resistance to the flow of air through pipes, and its effect upon brake applications both in service and emergencies, or rather attempted emergency applications, but some years ago we learned that the compressed air could be withdrawn from the long brake pipe in practically the same time whether valve handle is used in service or emergency position, that is, if the triple valves do not assist in the reduction of brake pipe pressure, the volume of compressed air in the brake pipe can be expanded or reduced to the same figure in practically the same length of time whether the valve handle was in service position or whether the angle cock on the pilot is opened.



STEVENS SYSTEM —OF— CAR BRAKE LEVERS.

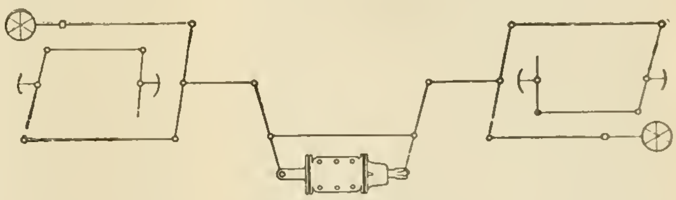
The various makes of swing joints and patent brake pipe connections between the engine and tender have also been viewed with some misgivings, but some additional light has been thrown on this subject by Mr. P. H. Donovan, M. E., of the Westinghouse Air Brake Co., in a paper on the subject of pipe and pipe friction, prepared and read by him before the nineteenth annual convention of the Air Brake Association. The tests made by Mr. Donovan bear upon the subject of initiation and propogation of quick action, and we do not know of any series of tests that have ever brought out any reliable information on this important phase of air brake operation, and his efforts in preparing this paper will be appreciated by every air brake man in the country.

As a preliminary test, which need not be associated with the train tests, a reservoir of 50,000 cubic inches capacity was utilized and the time of escape of air pressure under several different conditions was noted.

Some special apparatus was used during the tests, and the elbows used were of special fittings, a design which permitted the same inside diameter as the same size of pipe and were three times longer than their inside diameter.

The time of blow down from 110 to 10 lbs. pressure under the different conditions is shown in the following table:

Blow down of pressure.	Conditions.	Time. Seconds.
110 to 10	1-inch special fittings	12.0
" " "	1¼-inch special fittings	6.5
" " "	20 1-inch elbows	42.0
" " "	20 1¼-inch elbows	16.5
" " "	200 feet of 1-inch pipe	62.0
" " "	200 feet of 1¼-inch pipe	28.0



HODGE SYSTEM —OF— CAR BRAKE LEVERS.

A brake valve was then attached to the ends of the fittings with the following results:

Blow down of pressure.	Conditions.	Time. Seconds.
110 to 10	20 1-inch elbows	67.0
" " "	20 1¼-inch elbows	60.5
" " "	200 feet of 1-inch pipe	80.5
" " "	200 feet of 1¼-inch pipe	66.25

From an examination of the table it will be seen that in either case the blow down of pressure or escape of the volume was at a faster rate through 20 elbows than through 200 feet of pipe, and with the brake valve attached, the fall of pressure was a trifle faster through the 1¼-inch pipe.

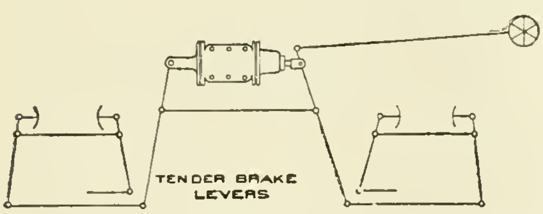
As previously stated, Mr. Donovan's chief consideration was the initiation and propagation of quick action when it is desired, and the effect of the different sizes of pipe and the use of elbows therein, and contrary to general supposition, it was

shown that the service operation of the brake is not seriously affected by the size of pipe or the number of elbows used, and if the service operation is affected, it is due to the volume of air to be expanded rather than resistance to flow.

The quick action or safety feature of the brake is affected by change in piping and the volume of compressed air to be expanded, and in order that quick action will positively occur there must be a reduction of not less than 8 lbs. per second at the first quick action triple valve, and it is well understood that certain conditions can prevent this rate of reduction, or reduce its rate before it reaches the triple valve.

An exhaustive series of tests was then conducted with 100 car trains and the necessary apparatus to insure accurate results, one and two locomotives were used with varied combinations of equipment distributing valves with and without quick action caps, and in different locations and at times the brake pipe vent valve was used on the tender.

In no case was there any venting device used on the engine and tender at the same time, and the arrangement of connection between engine and tender in one case was



made with a standard 1¼-inch hose connection, and in another case, 1-inch flexible metallic connections were used, adding elbows until 14 right angle turns were in use. This was intended to represent as severe condition as would be met with in service.

The object of these tests was to find what effect the different apparatus would have on the rate of brake pipe reduction.

We think that the tests covered the subject in a very thorough manner and are absolutely reliable, therefore our air brake readers should have the conclusions which are summed up in the following:

It is necessary to have a quick action valve or venting device located so near the brake valve, and so near the following quick action device, as will insure the drop in pressure in the brake pipe at the rate of 8 lbs. per second and this rate occur while the quick action device is in release position.

If the preceding conclusion is accomplished it is immaterial as far as quick action is concerned, whether the piping is long or short, or whether many or few elbows are employed. It is important, however, that the time of transmission of quick action throughout the train be as short as possible, and as length of pipe adversely affects this by added volume and some slight resistance, and elbows by resistance and a slight increase in volume, it is desirable to keep both to a minimum. Whenever the length of pipe (volume of the brake pipe) can be reduced by the use of an elobw, it is preferable to use the elbow.

That the deductions and rules made from experiments and in experience in air transmission do not apply to brake operation, and are misleading if employed in this connection, as here volume is the chief factor to be reckoned with, at least within the limit of present methods of installation.

That with the condition of long locomotives, double-heading, the complexity of piping that goes with this, in combination with long trains, one quick action device per locomotive is not sufficient to insure the propagation of quick action; in other words, one device per locomotive is not sufficient to secure the required drop of 8 lbs. per second on the first car. That a quick action device operated by a fixed and invariable volume is preferable to one that is operated by a variable volume.

That a quick action device governed entirely in its operation by rate of reduction is preferable to one whose operation is contingent upon or varied by rate of reduction and resistance to movement.

When triple valves are used, the rate of fall of brake pipe pressure must exceed 8 lbs. per second if the triple valves have been caused to assume or stop in service position before quick action reaches them

That the volume, that is, size of auxiliary reservoir, is a material factor in producing quick action with a triple valve, for the reason that the greater the volume, the more extreme adverse conditions may be before quick action fails to take place.

As near as could be determined it is necessary for each 600 cubic inches of brake pipe volume to suddenly open at least a one-half inch outlet to the atmosphere, it being understood that the quick action device is located at about the center of the 600 cubic inch volume.

That elbows and length of pipe are not the most important factors, that is to say, it will generally be found, when quick action fails, that it is due to other causes than these; for example, unnecessary restrictions in the piping, such as fins is the pipe, use of unions with small passages, kinks in the hose, pipe screwed too far into tees or elbows, etc. Also any and all of the circumstances and conditions mentioned in the previous conclusions; in other words, it would be a mistake to give consideration to elbows only as though their elimination would be a panacea for quick action failures

In closing, Mr. Donovan recommends that the foregoing conclusions be considered the "acid test" for all locomotive brake installations, including piping; the type of locomotive and service conditions for which it is intended determining the design that should be applied.

Join the Traveling Engineers' Association.

Secretary Thompson, of the Traveling Engineers Association, is making strenuous efforts to put his organization at the top so far as members are concerned. He has lately sent out the following circular:

ALL MEMBERS:

On account of business conditions increasing all over the country to a large extent, there have been a great many new road foremen of engines appointed, also a good many other men appointed to positions that make them eligible for either active or associate membership in the association, and to keep the association the best one of its kind in existence, the new blood is needed.

We now have a membership of about nine hundred, and it can be easily doubled by every member being a committee of one and get in one new member between now and convention time.

Our president is very anxious that our membership be increased, largely, during his term of office, and with very little effort on everyone's part they would make this the best year, in the way of new members, during the association's existence.

You understand, of course, that after February 1, the membership fee will pay the dues up to August 1, 1914.

Following is a copy of Article 3, section 2, of the Constitution relative to new members, showing you just who is entitled to active and associate membership:

ACTIVE MEMBERSHIP.

(a) Traveling engineers in active service whether assigned to duty on the entire system of railroad or on a single division of any road; their assistants, when said assistants have charge of a division and are responsible for the condition of the engine and the discipline of engineers and firemen to the same extent the traveling engineer is; provided that said assistants are not engaged in one line of duty only, such as instructions in firing coal properly, or inspector of engines in roundhouses.

(b) Those who have been traveling engineers and have been promoted to other positions of railroad service.

(c) Experts in air brake practice employed by the railroads or air brake companies.

(d) General foremen, when they have been promoted from the position of locomotive engineer.

(e) Roundhouse foremen, when they have been promoted from the position of locomotive engineer.

Air Brake Convention.

The Air Brake Association will hold its twentieth annual convention at the Planters Hotel, St. Louis, Mo., beginning Tuesday a. m., May 6. An unusually large attendance may be expected, as St. Louis is a large railroad center, and its location is very suitable for a national convention.

Owing to the fact that Mr. H. A. Wahlert has resigned the presidency of the association, to accept employment with the Westinghouse Air Brake Co., Mr. W. J. Hatch, of the Canadian Pacific Railroad will be the presiding officer of the 1913 convention.

The officers of the association are now as follows: President, W. J. Hatch, Canadian Pacific R. R.; first vice-president, L. H. Albers, New York Central Lines; second vice-president, J. T. Slattery, Denver and Rio Grande R. R.;

W. J. HATCH,
President, A. B. Association.

third vice-president, T. W. Dow, Erie Railroad; secretary, F. M. Nellis; treasurer, Otto Best.

The executive members are: C. H. Weaver, L. S. & M. S. R. R.; C. W. Martin, Penna. R. R.; T. F. Lyons, L. S. & M. S. R. R.; and F. J. Barry, N. Y. O. & W. R. R.

We have not been requested to make any reference to the business of the association, but we would suggest that all the members who can conveniently arrange to send their dues for 1913 to the secretary, Mr. F. M. Nellis, at 53 State street, Boston, Mass., and receive their membership cards before the opening day of the convention will greatly facilitate the work of the secretary, whose duties become more numerous and exacting each year, due to the constantly increasing membership and to the constant increase in the volume of business to be transacted.

Very few of the members are aware of the vast amount of correspondence that is now handled through this office, the complications of printing, illustrating, binding and correcting proof, the inquiries from various sources from all over the civilized globe, concerning air brake publications and inventions and the interest government officials and the Interstate Commerce Commission manifest in the recommendations of the association.

The papers to be presented and the subjects to be brought before the 1913 convention are:

1. Will the Triple Valve Operate as Intended? That Depends. S. W. Dudley.

2. Starting, Running and Stopping Long Freight Trains. F. B. Farmer.

3. Undesired Quick Action, Its Prevention and Remedy. G. N. Remfry.

4. Clasp Type of Foundation Brake Gear. T. L. Burton.

5. Friction and Wear of Brake Shoes. Robert G. Augur.

6. Recommended Practice. S. G. Down, chairman; Geo. R. Parker, H. A. Wahlert, J. R. Alexander, N. A. Campbell.

7. Topical subject, Air Hose Failures. T. W. Dow.

8. Topical subject, Steam Heat Drips. G. W. Martin.

The members presenting the subjects are well known to most of our readers and we wish to call attention to the constant revision in brake valve manipulation on long freight trains.

The members stand for progression, and constant changes in brake equipment and braking conditions necessitate changes in the recommendations for train handling that will produce the desired results. Mr. P. J. Langan, of the D. L. & W. R. R., who was the presiding officer at the 1909 meeting at Richmond, Va., has since that time continued to work in the interest of the association and his efforts to improve braking conditions and brake manipulation, are appreciated by the air brake men throughout the entire country. We believe that Mr. Langan is the foremost air brake expert in railroad service today, and by conducting numerous air brake and dynamometer tests, he has from time to time placed before the members information and recommendations as practised by himself and they are considered reliable.

His remarks upon the subject of brake valve manipulation are practical and emanate from practical experience, and the paper on Starting, Running and Stopping long freight trains, by Mr. F. B. Farmer, will be the source of enough air brake information to justify the attendance of every member. We also know what to expect from Mr. S. W. Dudley on triple valve operation while Mr. Turner will deliver a lecture upon one of the many phases of modern air brake operation.

The question of obtaining railroad transportation to the conventions has been simplified during the past few years and some of the members who have been compelled to pay car fare through the unwillingness of their superior officers to secure transportation for them will no doubt be enabled to attend the convention with less personal expense.

Just why motive power and operation officials should not urge the attendance of their air brake men is not entirely clear to us. The only way in which their air brake men can remain efficient and keep their practices economical and up to date, is through the work of the association as a body and the continuous improvements upon air brake apparatus, the

F. M. NELLIS,
Secretary, A. B. Association.

variety of equipments in use, the increasing length of trains and constant changes in operating conditions, necessitate intelligent supervision, inspection and repair work, and to successfully cope with the imposed conditions the air brake men require the assistance the experience of others is able to give them.

From past experiences we know that the unusually large attendances tend to impede the prompt transactions of business but ample provision will be made to insure a profitable return for the time expended in attendance regardless of the number of members that may be present.

The real reason why construction work has been suspended on the extension of the Grand Trunk Railway to Providence, R. I., has at last been discovered. It appears that the draftsmen who are plotting the surveys have not yet been able to spell Lake Chaubunagungamaug. A Welsh draftsman has been cabled for.

General Foremen's Department

Lubrication of Superheated Locomotives.

By JAMES SPELLEN,
Road Foreman of Engines, Buffalo, Rochester & Pittsburgh Railway, Du Bois, Pa.

The question of properly lubricating superheated locomotives has been pretty lively discussed, both in print, and from the lecture platforms, in this part of the country. The question seems yet a mooted one, and there are some who are not quite satisfied, even now, that this problem has been properly adjusted. I recall that when this type of power was being considered for use on the Buffalo, Rochester & Pittsburgh Railroad I was delegated to ride some of the superheated locomotives on one of the adjacent lines, to learn, if possible, something about the efficiency of the Pacific engines, and as to how they should be lubricated to the best advantage, i. e., prior to leaving on the trip a few questions were asked of the engineer in charge of the engine as to quality of valve oil used, and it was learned that the oil was a special oil for use in valves and cylinders of superheated engines.

The trip was completed without incident, but valve oil was used freely. The engine was not provided with any kind of a "drifting valve" and it was the custom of the engineer to shut off the throttle and allow the engine to "drift" occasionally. Yet there was nothing out of the ordinary occurred.

While at the terminal I examined one or two superheated engines which were having an examination made of the cylinder packing. It was noted that there were heavy deposits of oil on the piston heads, but the packing rings were broken, but not for the want of oil, however, and I afterwards learned that these rings were broken due to the fact that after the throttle was closed the engine "drifted" for a few miles, that the lack of lubrication at that particular time was the cause of the ring breakage.

The idea came, as a result of this investigation, that after the throttle was closed, the oxygen in the atmosphere passing in through the relief valves and getting in contact with oil on metal in steam chests and cylinders promptly carbonized, due to the heat in the metal, and was thus destroyed.

The reason for this destruction of lubrication may be reasoned out in this way. The steam leaving the boiler at 200 pounds pressure contains approximately 387 deg. F. After it passes through the superheater elements its temperature is raised considerably above this, say to 600 deg. F. This is provided a good bright fire has been maintained, which gives off the greatest amount of heat. Ordinarily speaking, the flash point of the common valve and cylinder oil is about 550 deg. F. If this oil is momentarily subjected to a temperature of 600 deg. F. and at the same instant the oxygen of the atmosphere can mix with it there is sufficient heat present in the steam chests and cylinder walls to promptly destroy the lubricating efficiency of the oil in question. Therefore, the reason for piston and valve rings breaking is obvious.

Therefore, in order to prevent the destruction of this oil it has been demonstrated that if the throttle is allowed to remain slightly open, not enough to cause any power being developed in the cylinders, but just to allow a small volume of steam to flow down over the hot metal of steam chests and cylinders, the steam will prevent destruction of the oil and thus avoid possible damage to the piston rings, etc. And then, too, there will be enough steam pressure in the steam chests to hold the relief valves to their seat, which will prevent an ingress of atmosphere with its accompanying oxygen.

In the modern superheated locomotive there is being applied what is known as "a booster valve," the intent being that this valve will supply enough of steam through two ⅜-in. pipes to the steam chests for the protection of lubrication. However, these small jets of steam have not been ample for this purpose, consequently the "cracked throttle" is being adhered to. It has been found that by the engineers following out this latter practice no trouble with broken piston and valve rings has been experienced.

It has been clearly proven with us here, in the operation of superheated locomotives that to get the best results lubrication must be constant while the locomotive is in motion, and this we adhere to carefully, thus receiving the best results.

Further referring to the "cracked throttle" practice we have been experimenting somewhat with it. It has been found that after the first five or six miles of a "drift" has been passed over, the throttle may be closed and allowed to remain so far the balance of the distance without damaging the valves of piston rings. It is assumed that while passing over the first five or six miles of the "drift" the metal in steam chests and cylinders will have partially cooled down below the flash point of the oil, thereby preventing the destruction of it.

It seems an awkward thing to have to resort to the use of a partially open throttle valve while a locomotive is passing over a portion of a division, especially "dropping down a grade" of 20 miles or so, for the protection of lubrication. Of course, this must be done at present under some conditions, and we do not hesitate to request that this be done, with a view of economizing in packing rings, etc., but what about the additional use of fuel? It is certainly a waste of fuel when steam is used down a grade, where the locomotive and train would run as well without it, but of the two evils, the least must be chosen. Packing rings are prevented from breaking in this way, but it is at the expense of the coal pile. The modern locomotive operators look at this method of practice as something that could be avoided, and there is no doubt but what it could, and it can be, and it ought to be. This reminds me of a bit of grim humor that I once observed. A gentleman, who had unfortunately been going around on crutches for several years, was finally taken to a specialist for treatment; the specialist talked to the cripple learnedly about his ailment for some few minutes, which was beyond his comprehension, producing in his mind something akin to astonishment, causing him to cry out, "Oh, dear doctor, don't take away my crutches." "We are not going to take away your crutches but we propose to remove the cause of their use, and you will throw them away yourself." And if the cause for the use of the "cracked throttle" is removed, it, too, will be abandoned.

The primary cause for the destruction of the lubricant, as was previously mentioned, is the oxygen getting into the steam chest with the atmosphere. It came in through the relief valve, and the relief valve is for no other purpose. Suppose the relief valve was plugged, or better, moreover, if it was not placed there there would be no oxygen or atmosphere getting into these passage ways, and there would be no destroying of the lubricant from this cause at least. We would offer instead some form of drifting valve, placed at some convenient place in the cab where it could be reached handily by the engineer or fireman, and when it became necessary to "drift" this valve could be opened and the vacuum created by the reciprocating pistons in the cylinder could be supplied with hot steam from the boiler to a thousand times better advantage than it could be by cold atmosphere. And in passing, it might

be well to mention the fact that the destruction of lubricant is not the only detrimental effect cold air has in its passage through steam chests and cylinders. When the metal in these parts has been heated up to say, 550 deg. F., due to the passage of hot steam through, or over them, the expansion in these metals is at its maximum; I don't assume there will be any difference of opinion about this. Then contraction follows expansion, particularly in this character of case, and what is the result? Cracked and broken bridges and damaged valve bushings. And these damages are among the most expensive items following in the wake of this "greatly favored relief vale."

It is true that there will be some slight amount of steam used in the operation of a drifting valve, but it will be meager, extremely so in comparison with the present method of operating with the relief valve. If it is a business proposition to require economy in the use of coal, oil, tools, etc., then there should be no reasonable argument against the removal of the relief valve.

Not so long ago I heard an argument in favor of the retention of this valve. I was passing over a Western road and in conversation with a mechanical gentleman; he gave it as his opinion that it was a good thing to have on a locomotive, and if the throttle leaked this valve could be blocked open and allow the escape of steam from the steam chests and prevent the possibility of the engine running into the turn-table. I said, "Yes, that is so, in that respect," but a better method would be to keep the throttle valves ground to seat, and there would be no steam in the cylinders except it reached there when some one opened it. And if the throttle did leak and for any reason the relief valve was not blocked open then the accident would occur anyhow. and instead of but one evil there would be two.

Electric Drive.

A feature of machine shop practice is the rapid adoption of electric drive not only in the larger machines, but also in the smallest kind of machine-driven tools. At the speed with which the change of drive is being made, it will soon be a rarity to see the obsolete type of one or more steam engines connected by long lengths of steam pipe and transmitting the power through a long series of shafts and pulleys. The loss of power in this way was rarely thought of, or, if thought of at all, it was looked on as an unavoidable waste. Recent careful experiments have shown that the amount of power absorbed in shafting varied in actual practice from 25 to 75 per cent. of the total power generated.

Since the general adoption of electricity as a motive power in machine shops the only problem seems to be whether individual motors or groups of machines driven by single motors are best in point of economy. The general drift seems to be towards a separate drive on each particular machine, and while the grouping system is common in many excellently equipped shops, the tendency seems to be in the direction of independent motors, the opinion growing in favor that the higher first cost is very soon made up by the larger economy produced by the separately driven machines.

The problem is one that naturally adjusts itself to the requirements and possibilities of the situation. Undoubtedly in some cases group driving will be best, and for others individual driving, much depending on the distances apart of the separate machines, as the length of shafting even if divided into sections remains a much greater loss than is generally believed.

Erie Apprentice Schools.

The Erie Railroad Company maintains apprentice schools in connection with five of its machine repair shops, and the general opinion is that the expense of maintaining these schools is likely to be one of the most remunerative enterprises undertaken by any corporation. The young men receive instruction in the science of their business and they are ready almost from the start to apply the principles to the practical operations in their daily work.

Besides the technical instructors, the company employs working mechanics to instruct the apprentices in various phases of their daily work. This was a much needed improvement for under the old system, a youth generally went to work attending a bolt cutter or to perform some simple operation that could be mastered in a day or two, and was kept at such work as long as his apprenticeship lasted. That is no ancient practice that has fallen into desuetude by any means. Railroad shops have been notorious for keeping apprentices at work which called for no instruction, permitting boys to learn as little as their personal dispositions moved.

The Erie people keep strict watch over the habits of the apprentices, and those not likely to make good mechanics are recommended to move into other occupations. The apprentices who have received the technical instruction are already found available for positions as foremen and several of them have proved themselves excellent officials.

Manual Training.

The educational press is very much occupied at present with discussions concerning the necessity for adding manual training to the ordinary class work performed by school children. Manual training, as popularly understood, is instructing children in the use of common tools; the nature of common materials; elementary processes of construction, and the execution and reading of working drawings, besides for girls the study of cooking, sewing and household duties.

The systematic study of tools, processes and materials is the essential feature of manual training; hence, the incidental use of tools without system is not, correctly speaking, manual training. Manual training is for all useful purposes a culture study, its functions being to develop the growth by developing the brain and increasing its control over materials through the hand and eye. All tool work, drawing, needlework, cooking, etc., begin with fundamental processes with suitable appliances upon typical materials. The articles constructed, the figures drawn, the garments sewed, or the dishes cooked represent the progress made.

Lathe Feeds.

Feeds should always be coarse enough to take a steady cut; feeds finer than 80 or 90 in lathes of 12 or more inches of swing frequently give an unsatisfactory surface due to the chip being too light to maintain a steadying effect. When the feed is too light the work has a surface produced by a mixture of scratches and burnished rings, for the tool point has alternately rubbed by riding and scratched by digging in.

If a hole is to be drilled in a piece of metal too small to bolt to the table and of such a shape that it is difficult to hold, it can usually be prevented from turning during drilling if a double thickness of emery cloth doubled face outwards is placed between it and the table.

The durability of steel will be high when both the hardness and toughness are high. It will be low when either the hardness or toughness or both are low.

Copies of Proceedings.

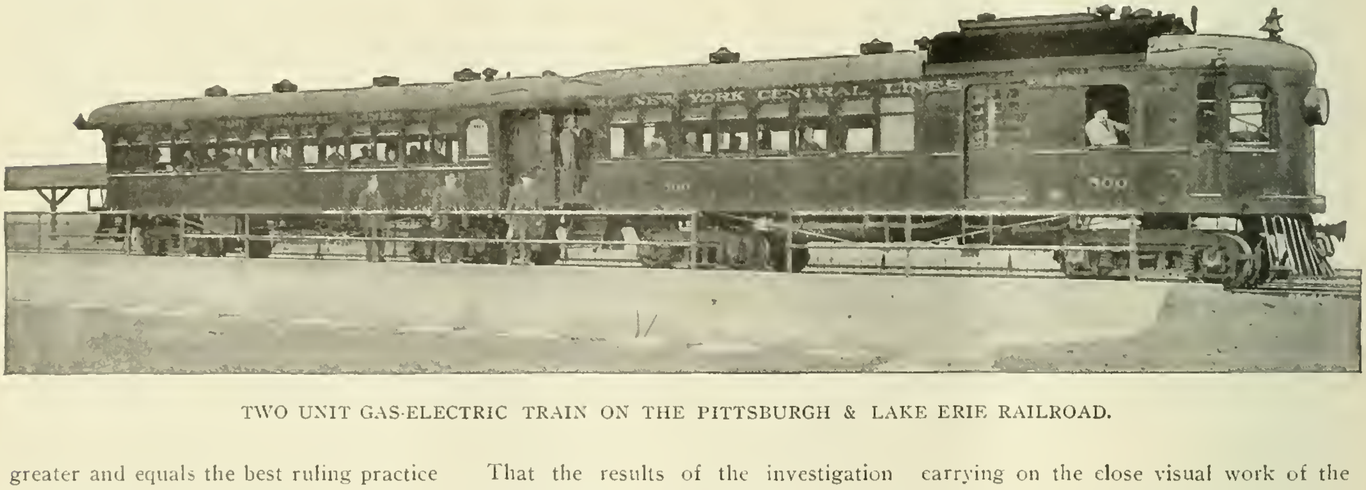
The secretary-treasurer of the International Railway General Foremen's Association announces that he has a number of copies of the proceedings of the 1912 convention, and anyone wishing to have a copy can obtain one by addressing him at 829 West Broadway, Winona, Minn. Several copies sent to members of the organization have been returned to him on account of the members changing their location, and not having notified him. Any member of the General Foremen's Association not having received his copy, please notify the secretary and one will be sent without delay.

Electrical Department

Two Unit Gas-Electric Train in Service on the Pittsburgh & Lake Erie.

The accompanying illustration is an excellent view of the two unit gas-electric train now in service on the Pittsburgh and Lake Erie Railroad between Pittsburgh and Beaver Falls, previously described in our issue of November, 1912, page 451. This is the only gas-electric unit of its kind in the country. The service of this gas-electric train is unique. It is the first instance where a self-propelled car of the type has been employed in this country on a main line heavy four-track road for local runs and interpolated between the schedules of limited trains. The motor car differs from the standard sizes heretofore developed by the General Electric Company. It is much shorter and is designed essentially for operation with a trailer. The seating capacity of the combination, however, is greater and equals the best ruling practice of interurban roads.

On the trial trip of the train from Pittsburgh to College, a distance of 31.2 miles, the outgoing run was made in 49 minutes, including three stops, at Coraopolis, Woodlawn and Aliquippa, respectively. Returning with two stops, the Pittsburgh station was reached in 42 minutes. Being equipped with motors of 200 total horsepower, the train is capable of averaging easily 50 miles per hour.



TWO UNIT GAS-ELECTRIC TRAIN ON THE PITTSBURGH & LAKE ERIE RAILROAD.

Postal Car Illumination Tests by the Baltimore & Ohio Railroad.

For the purpose of obtaining more adequate data on the subject of postal car illumination the Baltimore & Ohio Railroad, through its electrical department, has just completed an extensive series of tests and investigation of the subject covering a period of several months. The research was made last fall in Washington, D. C., on one of the latest type of 60-foot steel postal cars in use on the Baltimore & Ohio lines. In conducting the tests the assistance of illuminating experts of the leading reflector, car lighting fixture and incandescent lamp manufacturers was obtained, and in order to insure the greatest accuracy of test results the co-operation of the National Bureau of Standards was extended in calibrating the instruments, rating the lamps used and making photometric curves of all the light units tested.

The character of the visual work performed in a railway postal car requires a high quality of illumination, and the long hours during which artificial illumination is required make the problem of furnishing a reliable and economical supply of light a difficult one.

That the results of the investigation should be of general value the tests were carried out on a broad engineering basis, covering all practicable methods of car illumination available at the present state of the art. However, the investigation was confined solely to the question of providing proper and adequate illumination. The questions of maintenance, of the most desirable kind of illuminants, and of the operating problems connected with the generation of light were not considered further than with respect to their influence upon the quality of illumination provided. In detail the phases of the subject covered were the relative suitability of (a) Pintsch gas and electricity, representing the most important types of primary illuminants, as far as their influence upon the quality of illumination produced was concerned; (b) different types of reflectors and diffusers; (c) different types and arrangements of lighting units. The investigation consisted of illumination tests to ascertain efficiency and uniformity data as well as shadow effects obtained with various types of lighting units and spacing arrangements; also visual intensity tests to ascertain the intensities of illumination required in the different sections of the car by the character of visual work performed in these sections.

Two important features brought out by the investigation were: (1) That adequate illumination can be provided with no greater amount of light than is at present the general practice among many railroads to provide in postal cars, but unsatisfactory illumination has frequently resulted, largely due to improper arrangement of the light units and unsatisfactory types of reflectors; and (2) that the amount of illumination required for carrying on the close visual work of the postal service has been considerably overestimated.

In the bag rack section of the car the light units should be located along the center line of the car and the mounting height should be 7 ft. 7 in. from the floor to the center of the lamp filament or mantle in order to produce the least objectionable shadow effects as well as to eliminate shadows on the rear bag rack label. At the latter cases adequate illumination can be provided for only by light units independent of those used for illumination of the body of the car, and such light units should be located as far in front of the case as possible without shadows being thrown upon the work by the body of the mail distributor.

So far as the question of illumination is concerned the investigation showed that when proper location of lamps and pro-

per types of reflectors are provided, equally satisfactory results can be obtained with Pintach mantle gas lighting and electric lighting.

In determining upon the best types of reflectors for postal car service four qualities were considered: (1) Effect of resultant illumination upon the eye; (2) relative efficiency; (3) cleaning considerations; (4) liability to breakage. As these are not of equal importance the following relative values of these qualities were decided upon after considering the question from several different points of view. Out of a total of 100 points an importance represented by the following figures was assigned to each of the qualities under consideration:

Effect upon the eye	44
Efficiency	30
Cleaning	18
Breakage	8
Total	100

On this basis the relative suitability of the various types of reflectors for postal car lighting was found to be as follows:

CLASS OF REFLECTOR.

Aluminumized metal.
Heavy density opal glazed reflecting surface (specially designed for car lighting service).
Medium density opal glazed reflecting surface.
Porcelain enameled metal.
Medium density opal depolished reflecting surface.
Indirect lighting with enameled reflectors for gas lighting.
Mirrored glass (direct lighting).
Prismatic clear.
Primatic satin finish.
Reflecting and diffusing globes.

MAKE OF REFLECTOR REPRESENTED IN TESTS. IN THE ORDER ABOVE.

Holophane D'Olier No. 18460 body of car; Holophane D'Olier No. 18470 at letter case.
Holophane No. 18626 redesigned.
Phoenix CL-50.
Holophane D'Olier, 18461.
Macbeth-Evans Alada No. SF-1623.
Experimental enameled reflector.
X-Ray 555.
Holophane No. 18226.
Holophane 18226—SF.
Safety Corona No. 8026.

Extensive tests to determine the amount of illumination required for comfortable reading indicated that there was an appreciable difference in the character of illumination afforded by different types of equipment. Certain types gave illumination of such a character as to leave the eye in a less satisfactory condition for vision, thus requiring an increased intensity of illumination for adequate vision.

Extensive tests made to ascertain the intensities of illumination required showed that 2.25 foot candles on the reading plane was a safe value for minimum satisfactory intensity for continuous close visual work under illumination derived from direct lighting systems employing diffusing globes, opal reflectors, aluminumized metal, and prismatic reflectors. On the same basis it was found that 3.5 foot candles was ample illumination and that higher values were unnecessary for adequate service. It was further found that about one-half or slightly less of this minimum intensity value was required at the mouth of mail bags in the bag rack section of the car, on the face of the letter cases and in the storage section.

The relative comparison of the different types of reflectors is as follows in the order given the most efficient heading the list: Mirrored glass—prismatic clear, heavy density opal, medium density opal, aluminumized metal, enameled metal and bare lamps.

With gas lighting the aluminumized metal gives the best results and is nearly comparable with the mirrored glass.

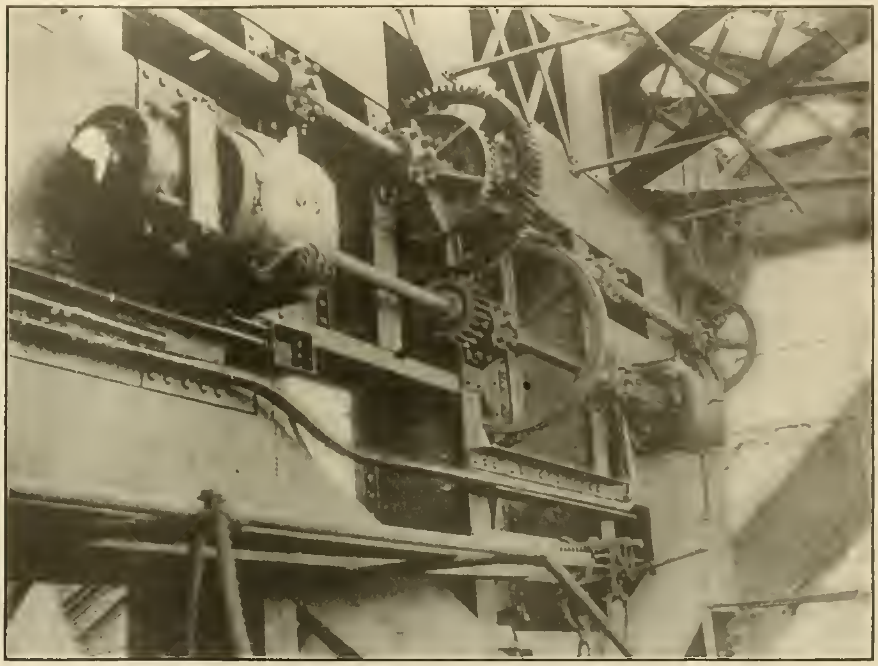
A feature calling attention to the importance of using proper types of reflectors in car lighting service for all classes of cars is shown in the comparison of illumination obtained with the most efficient type of reflector tested, the mirrored glass and with the bare lamps, in which the illumination obtained on the working plane where the reflector was used was practically 220 per cent. of that obtained with bare lamps, the number of lamps installed being the same in each case. In addition the ceiling of the car had been freshly painted a dead white, thus presenting more favorable conditions for the bare lamps than would generally be obtained in service. Further, the glare effect obtained from bare lamps is such as to render the eye much less efficient as well as susceptible to severe eye strain than where reflectors are used.

The minimum and maximum initial illumination values as well as the service illumination values required under the Post Office Department specifications, revised to December 28, 1912, were determined upon as a result of the Baltimore & Ohio Railroad Company's comprehensive tests in this connection, and which constitutes the only authentic data thus far available on this subject.

Motor-Operated Railroad Lift Bridges.

Practically all the railroad lift or draw bridges erected in the last few years, where electric current is available, are motor operated.

The motors shown in the illustration operate the six-tract bridge over the Bronx river and a similar installation for the six-track Hutchinson river bridge. The number of daily openings of these bridges varies. In the case of the Bronx river bridge the number of opening during the winter months is five daily and during the summer is twelve daily.



WESTINGHOUSE MOTORS AND METHOD OF APPLICATION TO THE SCHERZER ROLLER LIFT BRIDGE FOR THE N. Y., N. H. & H. R. R. OVER THE BRONX RIVER.

Each leaf, of two tracks, is operated by two direct-current motors, geared to pinions, which mesh with racks on the stationary part of the bridge. Under ordinary circumstances the two motors on each leaf are operated together as one unit, but either can be controlled separately and has sufficient capacity to operate the leaf. Both motors are provided with an electric brake and each leaf has a separate emergency brake.

Interlocking is provided so that signals must be set, derails, opened and bridge rail lock mechanisms released before the motors can be started. As the bridge opens signal lamps are lighted and bells are rung at four points in its travel. If the power is not shut off when the leaves are at the proper height, a circuit breaker is tripped automatically.

Mikado Type of Locomotive on the Chesapeake & Ohio

New Chart of this remarkable type of Locomotive nearly completed. Twenty-five thousand copies will be ready for distribution in May.

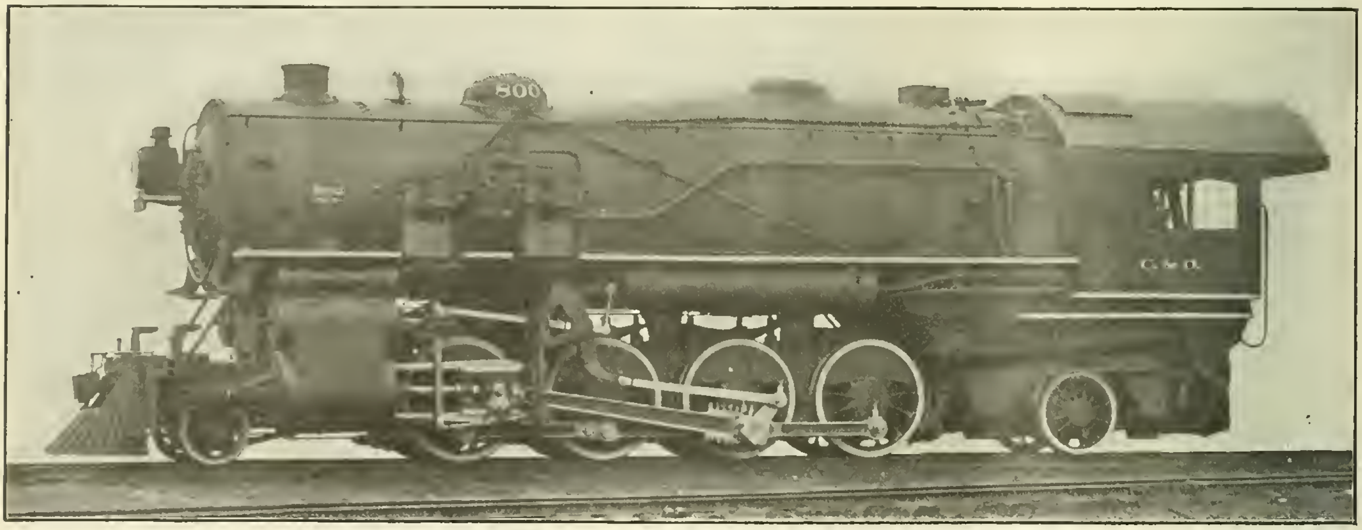
Every Subscriber to Railway and Locomotive Engineering will receive a copy

A year ago we took occasion to call attention to this locomotive, an illustration of which accompanies this brief description, and it will be recalled that considerable emphasis was given to the fact that it was at that time the most powerful type of Mikado locomotive then in service. It was designed to haul 4,000 tons over a long 3 per cent. grade at a sustained speed of 15 miles per hour. Its work has been very carefully observed, and among its best performances is the hauling of a train of 87 cars of 5,889 tons up an 8 mile continuous 2 per cent. grade, at an average speed of 16 miles per hour. It has also pulled a train of 112 cars of coal, weighing 7,590 tons over a division with an eight-mile ruling grade of 2 per cent., at an average speed of 15.5 miles per hour. In this work the locomotive developed a sustained drawbar pull of 57,500 pounds, at a practically uniform speed of 6½ miles per hour. This means that it maintained a power of at least 1,000 pounds in excess of its maximum rated power, based as usual on 85 per cent. of the boiler pressure of 175 pounds, at which point the gauge registered. It has developed 2,376 drawbar horsepower, or one drawbar horsepower for every 132 pounds weight of locomotive, the total weight of the engine being 315,000 pounds.

This design of locomotive is of special interest as the marked success it has attained has led to a number of later and equally successful designs which are now in service on many other roads. There are several features which are now coming into general use. These include outside steam pipe, screw reverse gear, self-centering valve stem guides, Schmidt superheater, Security sectional arch, Street mechanical stoker, and power operated grates. A new problem presented was large ash-pan capacity, which led to the development of a new design with six hoppers. In order to facilitate maintenance, a large number of details were used in common with the Mountain type locomotives. These details are given in the following list: Cylinders, cylinder heads, steamchest heads, piston, piston rod, piston-rod packing, valve and packing rings, valve rod and stem, valve-rod guide, valve-rod packing, crosshead, valve motion (similar), eccentric crank, crank pins (except front), side rods, main-rod bearings, frame pedestal caps, frame shoes and wedges, frame cross ties (between back and main drivers, between main and intermediate drivers), foot plate, chafing plate, pilot, pilot coupler, coupler pocket casting, coupler pocket pins, cab, parts of screw reverse gear, trailing truck complete, ash-pan rigging, driving boxes, driving box bearings, driving-box cellars, smoke-box front and door, exhaust pipe, dome, dome cap, dome casing, sand box, throttle, dry pipe, boiler tubes, boiler flues, firedoor, grates, grate details, grate shaker rigging, and tender and details.

In every road service the Mikado type has made the following comparison with Consolidations. The Mikado, weighing, with its tender, only 47 per cent. more than the Consolidation, has hauled 77 per cent. more tons in 87 per cent. more cars, at the same speeds. The Consolidation hauled 25.8 tons for each ton of its weight, including tender, and the Mikado hauled 31.2 tons, or about 21 per cent. more.

We may state that we have been preparing a new chart giving a detailed presentation of this remarkable type of locomotive. We expected to have had it ready for delivery to our subscribers with the April issue of Railway and Locomotive Engineering, but our readers will prefer to have it complete in every detail when finished, and it has taken a little longer than we expected. Every part will be named and numbered, so that it will be an educational chart, correct in every detail, and carefully drawn to exact scale in every part. The chart will be over 2 feet in length, and the work is being done in the best style of the engraver's art. It will prove an excellent help to all who are desirous of studying this particular type of locomotive, which is rapidly becoming the most popular type of locomotive for heavy service, and which in many particulars is preëminently the highest product of American engineering in locomotive construction.



2-8-2 TYPE OF LOCOMOTIVE ON THE CHESAPEAKE AND OHIO RAILWAY.

J. R. Gould, Gen. Supt. of Motive Power. American Locomotive Company, Builders.

Among the Railroad Men at the Arbitration Court

BY JAMES KENNEDY

It is interesting to look in at the grand ballroom of the Waldorf Astoria Hotel in New York, where fashion and frivolity hold their riotous revels in midwinter, and mark the change that has come over the spirit of the place. The Erdman Act has been at work all through the month of March. Here are representatives of many railroads, keen-eyed, clear headed, horny-handed. Legal luminaries armed with voluminous documents are there. Firemen with little books in their pockets full of facts and figures. Engineers with charts and maps and schedules in bewildering profusion. Flanking the squared arena where the battle is going on are a score of newspaper men smoking like soft coal burners, but busy as bees. On a raised platform against the gilded wall are the three arbiters: Mr. W. W. Atterbury, representing the railroads, Mr. Albert Philips, representing the Firemen, and William L. Chambers, chairman.

In the front row are Mr. W. S. Carter, president of the Firemen's Brotherhood, and Mr. Elisha Lee, assistant manager of the Pennsylvania railroad. These two are the star performers, and they fill their places admirably. Mr. Carter, rubicund, ready and irrepressible, is an engaging character, the delight of the newspaper men, and the pride of the Order which he so worthily represents. Mr. Lee, suave and eloquent, learned in law and gentle in voice as a woman. The two are finely matched, and like the real gentlemen that they are they occasionally help each other. There are no quarrels, Mr. Carter calls for his witness, and better witnesses were never heard in a court. Cicero said that we are all eloquent in the things that we know. This is only half a truth, as we have not all acquired the art of expression. The stories unfolded are graphic in description, with touches of pathos and tragedy that melt every heart. Here is a clean-looking, athletic young man, who has been firing a locomotive seven years. He never drank a drop of alcohol in his life—so he swears. He never saw the inside of a theater—since he was married. He fires an engine 106 miles for $3.30, and it takes from 12 to 16 hours to make this short journey. He sleeps in a ramshackle shed at the far end of the road, and is kept awake by the rattle of loose jointed engines under the window. There are about 50 others in the same caravansera, lying down and getting up at all hours, and he pays 15 cents for his night's lodging. Then his meals—a kind of gruel that we read of as being common in European prisons, and a cake of the dog biscuit variety, and coffee so muddy that the sugar refuses to sink in it. This kind of living costs him $25 a month away from home. Then his humble home needs all of the remainder. Holidays he has none. Never took a run to the country except on the foot plates of a locomotive and that can hardly be called a health resort. And after seven years of a life like this he is in debt! Surely this is some little melodrama that Mr. Carter and his associates have framed up. There is a silence in the great ballroom and Mr. Lee rises up, and, did the fireman have his pay raised in April, 1908? And again in August, 1909, and again in October, 1910, and still again in May, 1912? He had.

The newspaper men are smoking again, and the pencils are moving like chain lightning, and the pendulum is going the other way now, but Mr. Carter is up in an instant. And what pay had the fireman in 1907? He had $3.20, and now $3.30. After having his pay raised four times—how was that? Well the engines were larger, and the trains about three times heavier, and they could not make the same mileage, and the increase per mile did not amount to anything, it took more time to go the distance, not speaking of the time spent in looking for tools that were always missing, and longer trains to make up that took more time, and waiting for passenger trains to pass, and—but the curtain drops and Mr. Carter brings out the president of the Carpenter's Union, a solid man, full of facts and statistics. He has the carpenter's wages in all the eastern cities at his finger ends, and what has this to do with the firemen's grievances? Wait. This is one of Mr. Carter's clever moves. Carpenters get $4 a day for 8 hours work. Every hour after that is paid double. How much for 12 hours? $8. How much for 16 hours? $12. The vision of the poor fireman rises upon the scene, and the carpenter is rich beyond the dreams of avarice until Mr. Lee takes him by the hand, and the story of the carpenter's apprenticeship comes out, and the price of his tools, and the time he loses, and the invisible overtime that he never made in his life nor ever will, except in the case of a big fire or some disaster, and what chance has he of a promotion as a fireman has to be an engineer. He has about the same chance to become a superintendent of building as a fireman has to become a general manager. Then the curtain drops on the carpenter and Mr. Carter and Mr. Lee get ready for another round.

Here is a Life Insurance man now, and it comes out that of every thousand persons that pass into the beyond ten are killed accidentally. Of every thousand firemen that lay down their scoop for the last time fifty-four are killed. Five times more hazardous than other occupations. Mr. Carter impresses this upon the arbitrators. Mr. Lee wants to know where these figures were made. Common statistics, or brotherhood, or where? Made in Germany? Yes. America was behind Germany in some things.

Here is an engineer now that has kept one eye on the steam gauge, and the other on the prices of things, and he gives a list of fifteen varieties of food supplies and their prices. His vision covers seven years. The increase is about 18 per cent. Then he has a list of engines and he follows them as far as human eye can reach, and the increase in the wages of engineers and firemen is not visible to the naked eye, while the price of the things they must necessarily buy and eat grow in greatness year by year. Mr. Lee wants to know about potatoes and sugar. Getting cheaper all the time. Mr. Carter wants to know if the engineer could reconcile himself and his family to live on these two things. He could not.

Flashes of light come out here and there that give one a start on the application of some of the rules. Here is a fireman now that has been disciplined. He was on an engine in July last year, the first time that he had been on that particular engine. The firebox was over 75 square feet in dimensions. He had not time to look up. The mercury was sizzling about 120 deg. F. in the thermometer. The sweat ran into his eyes and he could hardly see. The engineer was gasping for breath and they ran past a signal a little distance. They turned back and nobody would ever have known anything about it, but the engineer was an honest man and told the truth, and he got thirty days to think it over in the valley of humiliation, and the fireman got four days. And Mr. Carter wanted to know if the engineer's name was George Washington. Mr. Lee is having his innings now. The game is being well played. It could not be in better hands. But whatever the result may be it may not be satisfactory. Two of the arbiters, of course, have their minds made up in advance. The third is swamped in an avalanche of evidence that no single human mind could digest. That good will come of it is certain. In the very nature of things we may soon have a Commission dealing with wages, just as the Interstate Commission deals with rates, and the upper and nether millstones of wages and labor on an occupation so arduous to the workmen and so important to the public, may by and by be managed with some degree of precision worthy of the vital problem involved.

We will see the end next month.

Items of Personal Interest

Mr. W. Canaran has been appointed superintendent of shops of the Wabash at Springfield, Ill.

Mr. T. J. Lowe has been appointed fuel agent of the Canadian Northern, with office at Winnipeg, Man.

Mr. L. A. Hardin has been appointed general foreman of the Chicago & North Western at Boone, Iowa.

Mr. H. Trewick has been appointed master mechanic of the Northern Pacific, with office at Seattle, Wash.

Mr. C. A. Dunham has been appointed signal engineer of the Great Northern, with office at St. Paul, Minn.

Mr. S. K. Dickerson has been appointed superintendent of motive power of the Big Four, with office at Indianapolis, Ind.

Mr. W. R. Meeder has been appointed master mechanic of the Chicago-Eastern Illinois, with office at Villa Grove, Ill.

Mr. Geo. Rommel has been appointed master mechanic of the Philadelphia & Reading, with office at Wilmington, Del.

Mr. F. L. Holt has been appointed master mechanic of the Missouri Pacific at Falls City, Neb. He succeeds Mr. J. D. Young.

Mr. E. B. Van Valion has been appointed general foreman of the Rock Island shops at Forty-seventh street, Chicago.

Mr. Wm. Henke has been appointed master mechanic of the Nezperce Idaho, at Nezperce, Ida. He succeeds Mr. M. H. Page.

Mr. C. E. Cramer has been appointed master mechanic of the San Pedro, Los Angeles & Salt Lake, with offices at Milford, Utah.

Mr. P. R. Moore has been appointed acting road foreman of engines of the Bangor & Aroostook, with office at Houlton, Me.

Mr. T. H. Summerskill has been appointed superintendent of motive power of the Central Vermont, with office at St. Albans, Vt.

Mr. J. E. Gardner has been appointed electrical engineer of the Chicago, Burlington & Quincy, with headquarters at Chicago, Ill.

Mr. W. G. Reid has been appointed general foreman of the Arizona Eastern at Globe, Ariz., in place of Mr. Max Fiedler, promoted.

Mr. R. E. French has been appointed master mechanic of the Liberty-White, with office at McComb, Miss. He succeeds Mr. W. C. Blount.

Mr. F. S. Hubbard has been appointed traveling engineer of the Lake Shore and Michigan Southern, with headquarters at Collinwood, Ohio.

Mr. Ray Ryan, formerly roundhouse and machine shop foreman of the Baltimore & Ohio at Glenwood, Pa., has been transferred to Foxburg, Pa.

Mr. Marcus A. Dow has been appointed general safety agent of the New York Central & Hudson River, in place of Mr. George Bradshaw, resigned.

Mr. Robert. J. McCaw has been appointed general foreman of the Chicago & North Western at Council Bluffs, Ia. He succeeds Mr. E. T. Breen.

Mr. O. Tefteller has been appointed superintendent of locomotive fuel service on the St. Louis, Brownsville & Mexico, with headquarters at Kingsville, Tex.

Mr. B. C. Horton has been appointed superintendent of locomotive fuel service on the New Orleans, Texas & Mexico, with headquarters at De Quincy, La.

Mr. C. E. Cramer has been appointed master mechanic of the San Pedro, Los Angeles & Salt Lake, with office at Milford, Utah. He succeeds Mr. T. M. Vickers.

Mr. M. J. McCarthy, formerly superintendent of motive power of the Baltimore & Ohio at Baltimore, Md., has been transferred to a similar position at Cincinnati, Ohio.

Mr. J. A. Barnes has been appointed road foreman of engines of the Wabash at Decatur, Ill., and Mr. W. W. Nall has been appointed to a similar position on the same road at Peru, Ind.

Mr. F. T. Owens has been appointed master mechanic of the Denver & Rio Grande at Pueblo, Colo., and Mr. A. B. Philips has been appointed general foreman on the same road at Salt Lake City, Utah.

Mr. C. F. Schraag has been appointed general foreman of the Chicago & Eastern Illinois at Brazil, Ill., and Mr. J. N. Powell has been made road foreman of equipment on the same road, with office at Danville, Ill.

Mr. W. E. Anderson, formerly master mechanic of the Colorado & Southern at Trinidad, Colo., has been transferred to Denver, Colo., in place of Mr. H. W. Ridgway, whose promotion was announced last month.

Mr. N. C. Bettenberg, formerly locomotive foreman of the Great Northern at St. Paul, Minn., has been appointed master mechanic, with headquarters at Crookston, Minn., succeeding Mr. J. W. Smith, transferred to Duluth, Minn.

Mr. M. B. McPartland has been appointed general foreman of the locomotive department of the Rock Island Lines, with office at Cedar Rapids, Iowa. He succeeds Mr. L. C. Meyer, who has been assigned to other duties.

Mr. D. E. Leary, formerly road foreman of engines and roundhouse foreman of the Atchison, Topeka & Santa Fe at Fort Madison, Iowa, has been appointed fuel inspector on the same road, with headquarters at Amarillo, Tex.

Mr. G. W. Seidel, formerly superintendent of shops of the Chicago, Rock Island & Pacific at Silvis, Ill., has been appointed superintendent of motive power of the Minneapolis & St. Louis, with offices at Minneapolis, Minn.

Mr. J. F. Green has been appointed master mechanic of the Wabash at Decatur, Ill. He succeeds Mr. Peter Vosen, and Mr. A. W. Blethem has been appointed road foreman of engines on the same road at Springfield, Ill.

Mr. G. I. Murphy has been appointed traveling engineer of the Denver & Rio Grande, and Mr. D. C. McCarthy has also been appointed to a similar position on the same road, both having headquarters at Grand Junction, Colo.

Mr. J. H. Suhl has been appointed foreman of the Atchison, Topeka & Santa Fe at Las Vegas, N. M., succeeding Mr. P. I. Costello, and Mr. H. Blake has been appointed road foreman of engines on the same road at Amarillo, Tex.

Mr. William Garstang, who has long been superintendent of motive power and master car builder of the Big Four, has, at his own request, been relieved of a portion of his duties, and has been appointed master car builder of the same road.

Mr. Abraham Lucas, formerly general foreman of the locomotive department of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis., has accepted a position with the Jacobs-Shupert U. S. Firebox Company, Coatesville, Pa., with headquarters at Chicago, Ill.

Mr. T. W. Callahan, formerly master mechanic of the Great Northern at Superior, Wis., has been transferred to the Kalispel division in Montana, and Mr. J. W. Smith, formerly master mechanic of the same road at Crookston succeeds Mr. Callahan at Superior.

Mr. J. M. Davis has been appointed master mechanic of the Colorado & Southern at Trinidad, Colo. Mr. Davis was formerly general foreman of the Denver shops of the same road, and has been prominently identified with the Railway General Foremen's Association.

Mr. S. W. Mullinix, mechanical superintendent of the second district of the Rock Island Lines at Topeka, Kan., has been appointed superintendent of shops at Silvis, Ill. Mr. C. M. Taylor, mechanical superintendent of the third district at El Reno, Okla., succeeds Mr. Mullinix, and Mr. L. A. Richardson, master mechanic at Chicago, succeeds Mr. Taylor.

Mr. Edgar N. Easton has associated himself with the railroad sales department of Joseph T. Ryerson & Son, with headquarters at New Haven, Conn., and Mr. John H. Craigie, formerly employed in the mechanical department of the Boston & Maine Railroad, is now associated with the railroad sales department of the above company, with offices at Boston, Mass.

Mr. George McCormick has been appointed general manager of the mechanical department of the Galveston, Harrisburg & San Antonio, the Houston & Texas Central, the Houston East & West Texas, the Houston & Shreveport, and the Texas & New Orleans, and superintendent of motive power and machinery of Morgan's Louisiana & Texas Railroad and Steamship Company, and the Louisiana & Western, with offices at Houston, Tex. Mr. McCormick succeeds Mr. J. W. Small, who has resigned.

Mr. George M. Basford, for a number of years assistant to the president of the American Locomotive Company, has accepted a position as chief engineer of the railroad department of Joseph T. Ryerson & Son, Chicago. His headquarters are at 30 Church street, New York. Mr. Basford has had a distinguished career, both as an engineer and as a writer on engineering subjects. He is still in the prime of life and much more excellent work may be expected from him. He has been especially prominent in signal engineering, and in 1895 he was chiefly instrumental in organizing the Railway Signal Association. Mr. Basford has also been particularly active in the better education of young railway men, and his many friends join in wishing him every good fortune in his new sphere of activity.

Mr. W. E. Wood, formerly of the firm of Raeder & Wood (Industrial Architecture) has severed his connection with that company and has opened offices in the Harris Trust Building, Chicago. Mr. Wood is an industrial engineer of long standing and has the combined experience due to shop and foundry practice as a works manager, followed by professional experience in connection with the design of a building, not merely as a building but as a labor-saving tool. His specialty is efficiency planning and economically executing the plan under skilled supervision. Aside from industrial plant construction, he was also consulting engineer for the new Galesburg station and office building and train shed for the Chicago, Burlington & Quincy Railroad, as well as work for the Chicago & Alton.

Obituary.

JOHN FRITZ.

The death is recorded last month of Mr. John Fritz, for many years general superintendent and chief engineer of the Bethlehem Iron Company. Mr. Fritz was a native of Pennsylvania and spent the greater part of his life in that state. He was born in 1822, and, from blacksmith's apprentice, he rapidly advanced in foundry work, and at the age of 23 he became superintendent of the Norristown Iron Works. He introduced many important innovations, especially in the magnitude of rolling mills, and in the increased size of steam hammers and other appliances. He received many honors from engineering societies both at home and abroad. He became identified with the development of Lehigh University, and designed and donated and superintended the construction and equipment of the Fritz Engineering Laboratory there.

WILLIAM ARROLL.

Sir William Arroll, the noted Scottish constructing engineer, died last month in his seventy-fourth year. His chief works were the reconstruction of the bridge over the River Tay, the first having been blown down in a gale in 1879, and the building of the great cantilever bridge over the Firth of Forth. This immense work, the largest of its kind in the world, was completed in 1890. The bridge has a total length of 8,295 ft. 9½ ins. The height is over 150 ft., while the towers rise to a height of 361 ft. Sir William was also engaged in the construction of many of the principal bridges in Great Britain, among others the Tower Bridge across the Thames in London, where two bascules, each weighing 12,000 tons, are raised and lowered by hydraulic pressure. He devised many accessories to the facilitating of his great works. Air hammers, oil heating of rivets, compressed air applied to shovels, and, probably the most important of all, he was the first to abolish scaffolding in bridge construction and projected the work from the ends by devices of his own. From a country blacksmith he became the greatest bridge constructor of his time.

RICHARD F. TREVITHICK.

The death was announced last month of Mr. Richard F. Trevithick, who was the first locomotive superintendent of the Japanese State railways. He was a son of Mr. Francis Trevithick, of Penzance, and grandson of Mr. Richard Trevithick, whose name will for ever be associated with the birth and development of the locomotive. The late Mr. R. F. Trevithick was the last of the trio of British engineers who made and operated the Japanese State Railways to leave Japan, as his services were retained some years after his engagement had expired. The first locomotives built in Japan were designed by him and built under his direct supervision.

C. E. GOSSETT.

The death is announced of Mr. C. E. Gossett, general master mechanic of the Minneapolis & St. Louis at Minneapolis, Minn. Mr. Gossett was in his forty-fourth year, having been born in Kentucky in 1869. He began his railroad career as a machinist's helper on the Wabash in 1886. Later he was employed as fireman and locomotive engineer on the Hannibal & St. Joseph and on the Chicago, Rock Island & Pacific. After serving some time as road foreman of equipment on the latter road he was appointed master mechanic in 1908. In 1910 he was appointed master mechanic of the Minneapolis & St. Louis, and in 1912 he was made general master mechanic of the road. His death is much regretted.

Bleriot the French Aviator.

Bleriot was lame; so lame that he was actually on crutches, as he waited for sunrise that fateful morning on the Calais sands. At last, when all was ready and he threw aside the crutches to seat himself in his monoplane, he cried gaily, "If I can't walk, I'll show the world that I can fly!"

Surely those gallant words must call forth a response from many a determined heart. Many of us are crippled, handicapped in one way or another for the great adventure of living. We cannot walk—cannot pursue the ordinary, natural human course. But above us sweep the blue distances of faith, of the supernatural life, of the things that are spiritual and eternal. We cannot walk; but the great voices of earth and heaven summon us to the miracle of flight!

Mississippi Northwestern.

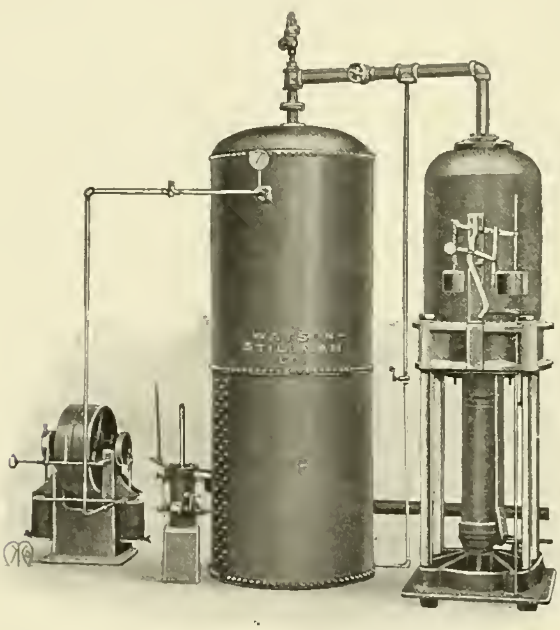
The Mississippi Northwestern Railroad, known as the Pine Belt, is proceeding rapidly with the survey, and construction work has begun at several points. President Mr. W. G. Seaver has established his headquarters at Pascagoula, Miss. Captain J. M. Searles has been appointed chief engineer; Mr. W. S. Cartter, superintendent of construction; Mr. R. C. Fraser, purchasing agent, and Mr. N. T. Jones, division engineer of the lines south of the Alabama & Vicksburg Railroad crossing. Mr. Seaver was for many years identified with the leading railroads in Mexico, and under his enterprising management the new railroad bids fair to be rapidly constructed. He is also a writer of marked ability, and his graphic stories of railroad life in Mexico are among the most interesting literary work in regard to railroads, and are widely in demand by the reading public.

Hydro-Pneumatic Accumulator.

In all large press equipments hydraulic accumulators are becoming almost indispensable. Pumps could be built to supply pressure direct, but the cost of such pumps makes them almost prohibitive.

The Watson-Stillman Company's latest development in hydro-pneumatic accumulators are rapidly taking the place of the older equipments, their new apparatus entirely dispensing with the heavy weights which are often undesirable on account of the shock caused by suddenly checking the descending weights causing damage or annoyance. The claims made by the company for their new accumulators are, in addition to the complete avoidance of shock, and that the apparatus occupies little space. It works unfailingly. It will do everything that a weighted accumulator will do, and more—it will provide two pressures—a low pressure for effecting that part of the stroke which is made against no resistance, and is a large percentage of the stroke of almost every hydraulic press tool, and a high pressure that effects the final squeeze. Furthermore the operating valve that can be used in connection with this system requires no more wheels or levers than the ordinary valve, because the change from low to high pressure is made automatically at the instant the ram encounters resistance, which the low pressure cannot overcome.

The accumulator that accomplishes all this is shown in the accompanying illustration. In the center is a large boiler-plate tank kept partially filled with water by the low pressure pump, the operation of which is controlled by the hydraulic governor shown immediately to the left of the tank. By its action, when the water reaches a predetermined level in the tank, the pump is stopped and when it falls below this level, the pump is started. Above the water an air pressure of 160 to 200 lbs. is maintained by the compressor shown to the left. The low pressure feed main is tapped into the bottom of this tank and through it the water is forced by the pressure of the air above it. This same air pressure is piped over to the accumulator proper and there by the force it exerts upon a piston moving in the large cylinder at the top, it balances the higher pressure from the pump, acting upon the piston in the small cylinder at the bottom. The areas of these pistons are made inversely proportional to the pressures upon them.



WATSON-STILLMAN HYDRO PNEUMATIC ACCUMULATOR.

The hydro-pneumatic accumulator is made for high pressures by simply omitting the low pressure pump and its connection to the air tank. Its users report that for this service it renders greater satisfaction than the weighted accumulator. These accumulators are made in any size for pressures from 300 to 6,000 pounds.

Lubrication of Pneumatic Tools.

Apart from the necessity of giving attention to the air admission into pneumatic tools by using strainers formed of wire netting and covered over with one or two layers of muslin in order that particles of foreign matter may be kept out of the valves, pistons and glands and other working parts of the tools, the lubrication of the tools should be carefully provided for. Valves and pistons for both hammers and drills require a light machine oil, and the oil is apt to be rapidly driven out. Such parts should be used freely and often, at least once every hour.

The Chicago Automatic Tool Company has designed an oiler for use in connection with all classes of pneumatic hammers, rock drills, Boyer and Keller piston and rotary drills. Tests have proven them very effective. They will also be found quite efficient in connection with the "Little Giant" drills, when Airoilene grease is not at hand for use in connection with this style of drill. The oil chamber is located in the center, the flow of oil being governed by means of a pin valve; the air passing around the oil chamber and a small volume through the needle or pin forming the valve, operating on the principle of an atomizer; thus the flow of the lubricant can be regulated to a nicety, the air carrying small quantities into all the working parts of the tools constantly while in operation, overcoming many vexatious delays previously experienced due to a lack of lubricant at the proper point and at the proper time. By the use of these automatic oilers, which are inexpensive, the cost of maintenance of pneumatic equipment can be reduced from 50 to 60 per cent.

Where concerns have large installations of pneumatic equipment it has been customary to maintain a force to look after the oiling of the same. After having tested a few of the automatic oilers it has been found that the oiling can be taken care of in the toolroom at night when the equipment is being put in shape for the following day's service.

We would urge very strongly that all users of pneumatic tools install these automatic devices and see that they are properly and constantly used. We not only recommend their use for the reason that it prolongs the life of the tools and increases their efficiency, but the reduction in maintenance cost is an item which should be constantly watched, and we are ever striving to aid our readers and our friends in this direction. The automatic oilers should be placed about 20 ins. from the tool with oilproof hose between oiler and tool.

Largest Turbo-Generator.

The Westinghouse Electric & Manufacturing Company has just received an order from the New York Edison Company for one 21,000 k. w. turbo-generator wound for either 6,600 or 11,400 volts, 3 phase, 25 cycle current. The generator has two poles and the speed of the set is 1,500 r. p. m. The generator is ordered complete with Westinghouse LeBlanc condenser and accessories. This set is said to be one of the largest turbo-generators ever built in this country.

RAILROAD NOTES.

The Transcontinental is in the market for 6,000 tons of 80-pound rails.

The Grand Trunk is in the market for 100 locomotives, it is reported.

The Erie has ordered 1,500 freight cars from the Western Steel & Foundry Co.

The Erie has ordered 10 Pacific type locomotives from the American Locomotive Co.

The Chesapeake & Ohio has ordered nine locomotives from the American Locomotive Co.

The Missouri Pacific has ordered five Mikado locomotives from the Baldwin Locomotive Works.

The Seaboard Air Line is in the market for 32 Pacific type locomotives and five six-wheel locomotives.

The Chicago, Peoria & St. Louis has ordered 10 consolidations from the American Locomotive Co.

The Kansas City Southern, it is reported, has contracted for 36 Mallet articulated compound locomotives.

The New York Central & Hudson River has ordered 10 electric locomotives of a new type from the General Electric Co.

The Pennsylvania announces an order for the construction of 170 locomotives of different classes at the Altoona shops.

The Hang Yang Iron & Steel Works has ordered two four-wheel saddle tank locomotives from the American Locomotive Co.

The Oregon Short Line is reported to be in the market for 800 gondolas in addition to cars recently ordered by the Harriman Lines.

The Buffalo, Rochester & Pittsburgh, it is reported, has ordered 12 Mikado locomotives and three switchers from the American Locomotive Co.

The Norfolk Southern is in the market for 300 steel underframe box cars, six steel underframe caboose cars and 160 steel underframe flat cars.

The Withers Construction Co., Joplin, Mo., has the contract for grading for the projected shops of the Missouri & North Arkansas at Harrison, Ark.

The Seaboard Air Line, it is reported, is making inquiries for 1,000 steel underframe box cars, 250 steel hopper cars and 250 steel underframe flat cars.

The Chesapeake & Ohio has ordered eight Pacific locomotives from the Baldwin Locomotive Works, and 12 Mallets from the American Locomotive Co.

The Western Maryland, it is reported, ordered 8,100 tons of 90-pound rails, dividing the contract between the Bethlehem Steel Co. and the Carnegie Steel Co.

The New York Central Lines are reported to be in the market for 38 switching locomotives, 3 Mallet locomotives, 13 Pacific locomotives and 50 Mikado locomotives.

The Lehigh & New England, it is reported, has decided to establish new shops at Bath, Pa. One and one-half million dollars will be expended on this and other improvements.

The Buffalo, Rochester & Pittsburgh has ordered 25 steel coaches and two cafe-parlor cars from the Pullman Co. It is also reported that this road is still asking bids on 1,000 gondola cars and 350 underframes.

The Kansas City Southern has ordered four six-wheel superheater switching locomotives with 20 x 28 in. cylinders, driving wheels 50 ins. in diameter and a total weight of 156,000 lbs. in working order, from the American Locomotive Co.

The Chicago & Western Indiana has ordered five eight-wheel switching locomotives with 24 x 30 in. cylinders, driving wheels 57 ins. in diameter, and a total weight in working order 212,000 lbs., from the American Locomotive Co.

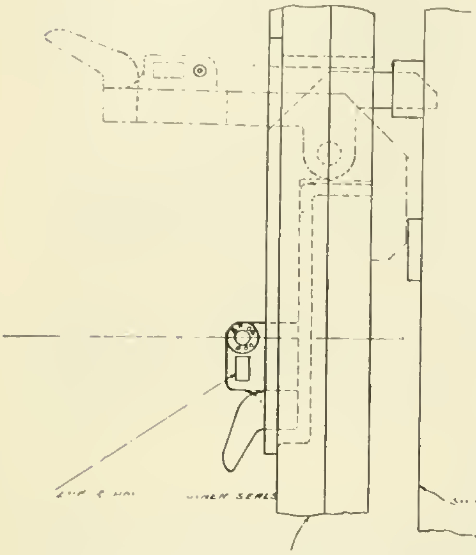
The Michigan Central will probably have work started in the early spring on the erection of a new roundhouse at Joliet. An addition to the present yards is also planned. This will be built opposite the plant of the Joliet Rolling Mills Co.

The Louisville & Nashville is said to be considering an expenditure of about $500,000 for enlarged terminal facilities, repair shops and other improvements at Louisville, Ky. This road has also plans for enlarging its yards at Lexington, Ky., which will probably cost about $500,000.

The Baltimore & Ohio has ordered 60 Mikado locomotives and 30 Pacific locomotives from the Baldwin Locomotive Works. This road has also given an order to the American Locomotive Co. for 10 Mallet articulated compound superheater locomotives with 26 x 41 x 32 in. cylinders, driving wheels 57 ins. in diameter.

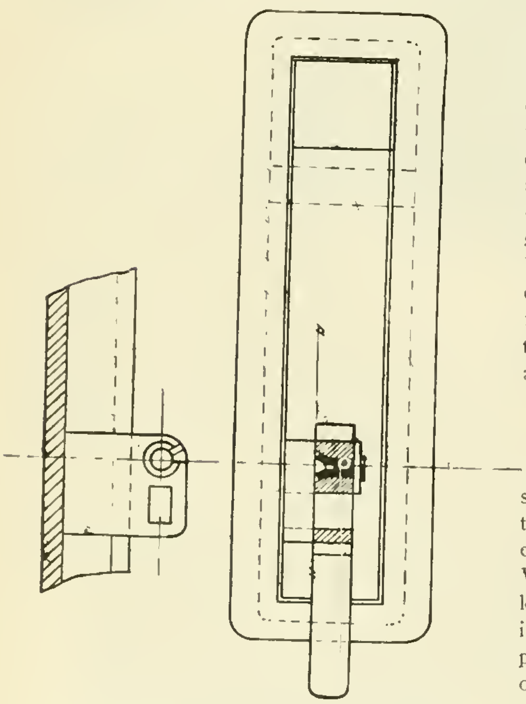
Rumsey Car Door.

The Rumsey Car Door and Equipment Company are meeting with much well deserved success since the introduction of their new car door. As we have pre-



RUMSEY CAR DOOR. FRONT VIEW SHOWING LOCK AND HANDLE.

viously stated, the door is absolutely proof against weather conditions. The chief feature, however, that is meeting with universal commendation is the combination lock and handle, the simple method



RUMSEY CAR DOOR. SIDE VIEW SHOWING LOCK AND HANDLE.

of operation of which is shown in the accompanying illustrations. The device automatically locks by gravity, whether the door is opened or closed, and the new form of rivet seal insures safety. The door cannot be opened until the handle is raised, and the raising of the handle not only breaks the seal but simultaneously opens the lock. The seal is made of lead, and little pressure is required in shearing off the seal. The device has the double merit of simplicity and efficiency.

A New Safety Ladder for Box Cars.

The Safety Steel Ladder Company, of St. Louis, Mo., are meeting with considerable success in introducing the all-steel safety ladder which was designed primarily to provide maximum safety for the train men and to facilitate bringing the ladder equipment of box and other high cars within the requirements of the United States Safety Appliance law.

This ladder has rungs riveted to stiles made from bar steel, and those parts on the car body are spaced to a convenient position by cast iron furring spools on the intermediate bolts. Spacing on top of the car roof is effected by bending the projecting stiles parallel with the roof, and by further bending the stile ends downward. The top construction differs somewhat for wood and metal roofs, but in other instances the roof grab irons are a firm part of the main ladders and require no holes in the roof. On wooden roof cars the stile ends of the side ladder bear squarely on the roof and one stile end of the end ladder is bolted to the side ladder stile, thus leaving no part on which trainmen would be apt to catch their feet or clothing. On metal-roofed cars, similar safety is effected by bolting the side ladder stile ends to the brakeman's platform. The stiles of the side ladder both extend far enough upon the roof to provide for the required roof rung, while the endmost stile extends far enough to form a roof grab iron in connection with the end ladder, also to permit of end and side ladders being secured to each other. Where the Safety Ladder is used it is claimed that a safe and simplified platform can be made and installed at less than half the cost of an old type platform and its fastenings.

Writing for the Paper.

An "Old Reader" who is moved to air some of his own ideas in our pages, writes to ask if his letter must be grammatically correct and free from mistakes in spelling. We refer to his letter because we have known of others who refrained from giving our readers the benefit of sensible, practical ideas because they were weak on spelling and grammar. Intended contributors need to have no fear on account of uncertain grammar or defective spelling. Every letter that comes in for publication is carefully corrected before being sent to the printer, and are sometimes read to a stenographer, who works them through a typewriter. Something valuable or interesting to write about is the chief point, and all railway men readily have that quality.

Master Boiler Makers' Convention.

The seventh annual convention of the Master Boiler Makers' Association will be held at the Hotel Sherman, Chicago, Ill., May 26, 27, 28 and 29. Arrangements have been made for the exclusive use of the second floor of the hotel during the convention for the exhibits of the supply men. This includes the use of a number of private rooms and a large banquet hall adjacent to the convention hall. Electric current, air, steam or water pressure are available for operating working models of machinery, etc., so that the exhibition of boiler makers' tools and supplies this year should be of particular value.

Too Much Strength.

How it does delight some lathesmen to come down on the wreck of a tailstock! There is not a particle of use in it for ordinary sized lathing; for a man who understands things will run year after year on ordinary work and never tighten but one of the bolts, and the tailstock will now slip. Another man will take the same lathe, and if it ain't well ballasted he is liable to pull the thing right over as he strains himself on the tailstock wrench.

. . . I have often thought that unnecessary screwing of certain bolts is a fair test of a mechanic's intelligence. I once got up the drawings for a planer to plane 5 or 6 feet square and 25 or 30 feet long. As a tool-holding arrangement I put in the usual two clamps with four good big screws. The man who ran this planer broke a bolt a week. We made new ones of every kind of iron and every kind of steel, but still they broke. A planer right alongside of this one, doing exactly the same kind of work, using the same tools, taking the same cuts on the same pieces but run by another man, never broke a tool bolt, notwithstanding there were only two of them and they were very much smaller. After the men were changed awhile the bolts began to break on the old planer and none broke on the new one. The trouble was this fellow ate too much beef. He never knew when he quit fooling with the wrench. These are the men who break tool post wrenches on lathes. They break any kind of an open-ended wrench you give them. A monkey wrench volatilizes in their hands; they strip bolts and nuts and spring face plates and angle plates and planer tables and burst pipe fittings and come down on the caps of journal boxes. If anything with a screw to it can be damaged they will damage it. If it is so strong they cannot damage it themselves they will screw it up so infernally tight that somebody will have to damage it to unscrew it. They will go home and screw the lid on the pepper box, and then grumble at the bruising of the bright work when the woman has to use a fork to unscrew it.

CHORDAL.

Demanding Weighing Scales.

People using the railroad in Florida and some other southern states, have lately discovered that they have been suffering intolerable injustice because the transportation companies have not been providing platform weighing scales and other facilities for weighing freight. The usual course of complaining to the railroad commissioners has been adopted and the probabilities are that the orders for weighing scales will be rapidly increased. A curious thing in this regard is that in Europe nearly every station is provided with weighing scales before it begins doing business. In the United States the weighing scale has been largely regarded as a superfluity.

Strathcona's Slush.

When Lord Strathcona was called upon to drive the golden spike into the last tie of the Canadian Pacific Railway, the foreman in charge of the section was told to make a hole in the tie so that the precious spike could easily be extracted and preserved under a glass case. As it was early spring, with a thaw setting in, the foreman bored out quite a substantial hole, and, to make the ceremony of "driving the spike" appear real, he carefully filled the deep pocket with slush. When Lord Strathcona, bending low before a distinguished gathering, raised the mallet and drove the huge nail far into the tie, a powerful squirt of melted snow instantly darted back at him, covering his long beard and immaculate clothes in the most unexpected and embarrassing fashion. But His Lordship did not forget to join in the chorus of half-smothered merriment that burst at his expense.

To Replace the Vacuum.

A plug railroad in Indiana had one locomotive equipped with two injectors, one of which had never worked. One day the second injector failed to operate and help had to be sent for from a distant machine shop. When the physician machinist arrived and tried to work the injector, he told the man in charge that the throttle of the injector leaked and broke the vacuum which prevented the instrument from raising the feed water.

"That's all right," commented the man in charge, "take out the vacuum and I shall send to William Sellers and Co. for a new one."

Misplaced Switch.

"No, siree!" exclaimed Bunkerton. "There wasn't any of that nonsense in my family. My father never thrashed me in all his life."

"Too bad, too bad," sighed Hickenlooper. "Another wreck due to a misplaced switch."

Books, Bulletins, Catalogues, Etc.

Engineer's Handbook on Patents.

Little, Brown and Company, Boston, Mass., has just published an excellent work on the above subject by Prof. Wm. Macomber, of Cornell University, wherein the author presents the theories which underlie successful inventions, and tend to guide the inventor on the best lines, both in regard to the law and the theory of patents. It is amazing how little the embryo inventor knows in regard to this important subject, and we would earnestly recommend a careful study of this book to all who desire to avoid the lines of thought which have resulted in past failure on the part of other inventors. The book informs him of what he should do to secure for himself the benefits of a successful invention. The book very clearly defines what is patentable, and quotations and illustrations fortify the arguments in a way that places the work as beyond controversy. It is, perhaps, the most important book on the subject, and coming, as it does, immediately after the recent revision of the patent laws, no earnest inventor should be without a copy. The book is elegantly printed, and bound in flexible leather, 288 pages. Price, $2.50.

Handbook of Railroad Expenses.

Mr. J. Shirley Eaton, formerly statistician, Lehigh Valley Railroad, has had a book just published by the McGraw-Hill Book Company, New York, on the above subject, and the work has the merit of being the product of long experience and careful thought. The intention has been to produce a handbook that would be reasonably complete for all the purposes of the operating officer, or for the railroad statistician and financier. All existing indexes of expenses have been carefully observed and freely used by the author. Abridged versions of the Interstate Commerce Commission are reprinted, and it is evident that the equipment for the production of the work has been complete, and in a handy form the subject has been fully treated in a manner that conveys the best efforts of the best men engaged in the work of which the book treats. 558 pages, flexible leather binding. Price, $3.

The Railway Goods Station.

A British book of more than common interest in regard to the control and operation of railway goods stations by Mr. Fred J. West, London district goods superintendent, South Eastern & Chatham railway, republished in America by Spon & Chamberlain, New York, 192 pages. Cloth binding, price, $1.50. The book treats very fully and clearly on station construction and necessary organization, the duties of foremen and inspectors, indoor staff, loading and unloading, the handling of stock, cartage, a suggested goods railway clearing house, and a variety of other topics, all of which are presented in a manner which shows that the author has thoroughly mastered the subject.

Book of Standards.

The 1913 edition of the Book of Standards, published by the National Tube Company, Pittsburgh, Pa., has just been issued, and as formerly, contains tables and useful information pertaining to tubular goods manufactured by the company, and in addition to which there is a vast amount of information in regard to the processes of manufacture, properties and characteristics of metal, and the possibilities of modern welded tubes and pipes, much of which is unknown even to many accomplished engineers. The book has the real merit of an almost absolute freedom from technical detail, so that the work readily takes its place as being among that class of books that is a reflex of the experience of actual workers and not the work of mere theorists. 559 pages, gilt edged, leather binding. Price, $2.00.

Catechism of the Automatic Vacuum Brake.

We are pleased to note that the above work, the author of which is Mr. Charles H. Gilbanks, Railway Quarters, Ruttam, India, is meeting with much success, not only among the railway men in India, but orders are being received from all over the world. As we stated in a review of the work last year, it is an excellent work, discussing the subject from a thoroughly practical standpoint, and is not only valuable to young men seeking information, but to older railway men who can obtain valuable facts from a careful perusal of the book. The price, postpaid, to all parts of India is 2 rupees 8 annas, or one dollar to America.

Wiring Computers.

The Simplex Wire & Cable Company, 201 Devonshire street, Boston, will send on request one of their "wiring computers," which gives by a single setting size of wire, voltage drop and current for any distance. Much laborious figuring is avoided by its use.

Stick to Your Work.

If some men would quit looking for a soft political snap and stick to their regular employment they would be better off financially.

Permanent Manufacturers' Exhibit

Railway Supplies and Equipment

Notes of the Exhibits and Meetings

Paint and Varnish.

The Forest City Paint and Varnish Company have an interesting display of paints and varnishes, and the special product, Nev-a-rust, is much in evidence. This article is in general use by a large number of railroad companies, bridge contractors, car builders, structural steel workers, roofers and others. Several of the railroads have adopted it as their standard for use on iron and steel structures. It consists of a black iron oxide and has a natural affinity for iron and steel, and is an enduring protection against rust and corrosion. In some cases a coating of Ferric red lead is first used on the metal, and Nev-a-rust for the finishing coat. The red lead preparation is composed of Prince's mineral brown and red lead combined in proportions tested by experiment to produce the best results. Great care has been taken to scientifically proportion the ingredients, and the result is that a degree of durability has been acquired that could not be surpassed. Mr. Walter B. Wood is the Chicago manager of the company. The main works are at Cleveland, Ohio. Mr. Wood's address is Karpen Building, Chicago, Ill.

Railway Utilities.

The Railway Utility Company exhibit, a variety of fine railway utilities, among which may be mentioned Automatic Thermostats that are so constructed that they maintain an equable car temperature in all conditions of service. Car ventilators and lamp jacks are also shown that keep the cars cinder proof. There are also samples of automatic freight car door locks that keep the door securely locked open or shut, and have withstood the most rigorous tests. In addition to these there are also shown in actual operation the company's portable electric vacuum car cleaners for the perfect sanitary cleaning of cars while en route, and which have already tended greatly to improved passenger service.

MAIN ENTRANCE, KARPEN BUILDING, CHICAGO.

Locomotive Steam Gauges.

Prominent among the fine exhibits are the "Tre-Foil" locomotive steam gauges, manufactured by the Bogardus Company, Chicago. These gauges have been proved to be admirably adapted for locomotive service. The non-straining feature insures accuracy in spite of strains, vibrations and changes in temperature. It is the only locomotive gauge made with a spring cleaning attachment. It is easily taken apart, quickly cleaned, and easily kept in perfect order. Another interesting exhibit is what is known as the "Trident Hylo" water alarm. It automatically indicates the exact depth of water in the tank, and also gives alarm at both high and low water mark. The material and workmanship of these locomotive attachments are of the best.

Water Treating Preparations.

The Dearborn Chemical Company have brought their new system of water analysis to such a degree of perfection that a gallon sample of water from any district is all that the company requires, and in a short time the water treating preparation is ready, and in every instance it proves a preventative of foaming, pitting, scale, as well as leaks in locomotive boilers. Samples are on hand in the exhibit building, and collections of scale and incrustations showing the effects of various kinds of water on boilers previous to using the Dearborn Company's preparation. It is the scientific method of overcoming bad water troubles, and effects considerable saving both in fuel and repairs. It has repeatedly proved its efficacy in some of the worst districts in America, and when the preparation is once introduced it is invariably continued in use.

Electric Headlight.

An unusually fine exhibit is made by the Pyle National Electric Headlight Company. This company's products are so well known that little more need be said than that in the Karpen building they are seen in their perfection. Beside the types of headlights that have already earned a world-wide reputation, their new type "E" turbo generating set is also on exhibition. This new type, in its perfected form, evaporates a smaller amount of water per engine horse power than any other turbo design for similar service.

Railway Supplies.

A variety of railway supplies is shown by the Joliet Railway Supply Company. Among the most prominent are the Huntoon Safety high-speed brake beam for P. C. air brake equipment. This has been shown to be the strongest brake beam per pound of metal ever constructed. Accompanying are automatically adjustable brake heads and brake beams for all classes of equipment. Another equally important device is the Perry-Hartman self-centering free radial anti-friction truck, consisting of the Hartman new type of improved self-centering anti-friction ball and roller center plates. This is the only self-centering center plate manufactured, and accompanying this are the Perry self-centering, anti-friction roller side bearings with safety turtle-back covers. These are suitable for all classes of freight and passenger equipment. A sample of these durable bearings are shown that have been in service over seven years and passed through 700,000 miles in operation.

Brakeshoes.

The Kincaid brakeshoe, which has the double quality of durability with self lubrication on the flanges of the engine or car wheels is attracting considerable attention among the visitors at the Exhibition. Its merits are universally acknowledged, and its adaptability and simplicity may be seen at a glance. It is the very latest improvement in the matter of automatic lubrication of wheel flanges. Its use means the complete eradication of sharp flanges and consequent derailments, and groanings while rounding curves. The cost is the same as other brakeshoes, while the lubricator costs literally nothing. It has been thoroughly tested and met the approval of many eminent authorities.

Flexible Ball Joints.

The Baro Brass and Joint Company have on exhibition an interesting variety of their latest productions in flexible ball joints. These joints are especially designed for service between engine and tender, and steam joints, besides being readily adaptable for compressed air and lubricating and fuel oil connections, and also for use in roundhouse blower sets, as well as for blow-off sets of all kinds. These joints, while being applied to new uses, have been in successful service for more than five years.

Public Cups.

The clamor, wise or otherwise, for individual drinking cups, especially in railroad passenger service, has been admirably met by the Public Cup Vender Company, who exhibit cups and methods of holding them that leave nothing further to be desired. This company is the owner of the Luellen patents on individual drinking cups, and also the special cup dispensing apparatus. These cups are open in form, of artistic design, and are made of wood pulp paraffined. They are not only manufactured, but are also dispensed under perfect sanitary conditions. The cup venders are easily installed, and are neat and attractive in appearance, and have been thoroughly tested by years of hard usage under all sorts of conditions among all sorts of people. The tube holding the cups is of heavy flinted glass. Concealed Yale locks of a combination known only to the manufacturers and in regular series, protect both the encircling band and cup tube. This combination has already come into general use by many railroads and terminals, and all who have had opportunities of testing the merits of the device agree as to its complete adaptability to the requirements of the service. The holders are in a variety of forms, and are easily installed.

Western Railway Club Meeting.

One of the most important meetings held in the Karpen building during the month was that of the Western Railway, held on Tuesday evening, March 18. Mr. E. C. Schmidt, professor of railway engineering of the University of Illinois, read a paper on the subject of "The New Locomotive Laboratory at the University of Illinois." The laboratory is now nearing completion, as are also extensive facilities for the department of railway engineering. It is expected that the entire plant will be in full operation by the middle of April, the locomotive by means of which the plant will be tried upon being one of the consolidations loaned by the Illinois Central Railroad. The club by a unanimous vote agreed to formally accept the invitation extended by Professor Goss, the dean of the faculty, to attend the dedicatory ceremonies incident to the opening of the plant. These ceremonies will be held at hte university on May 7 and 8, and at that time special tests will be shown for the edification of all who may be able to attend.

In the course of his remarks Professor Schmidt pointed out that until about twenty years ago the only other source of accurate and specific information concerning locomotive performance was the data derived from specially arranged road tests. Such road tests were conducted as early as 1835-1840, and they have ever since been a fruitful source of important knowledge. For certain purposes they will never be displaced. Anyone who has conducted such tests is well aware of their difficulty and expense. Every measurement connected with the determination on the road of boiler and engine performance of the locomotive is much more difficult than in the stationary plant. The measurement of coal and water and the taking of indicator cards, for example, are very difficult operations under the conditions of road service, and operations whose accuracy can be assured only by great effort and skill. Nevertheless, when the importance of the purpose warrants the expense, the difficulty of making road tests would be willingly incurred if their usefulness were not otherwise limited. It is, however, greatly limited by the fact that on the road many of the conditions of operation are entirely beyond control; and consequently even the most skilfully and conscientiously conducted road tests sometimes fail to produce conclusive evidence. In comparing two locomotives of similar design by means of road tests, small differences in their performance are frequently overbalanced by differences in the conditions surrounding the tests which are entirely unavoidable. For such reasons it is practically impossible, for example, to satisfactorily determine by road tests, the difference in the economy of using two similar kinds of coal, or to determinue the effect upon steam consumption of changes in valve gear design. The limitations and disadvantages of road tests are not thus emphasized through any lack of appreciation of the extent of their contribution to the art of locomotive engineering, but to make clear their inherent inadaptability to some purposes. On the other hand, they offer the means of settling certain questions which cannot easily be treated in a locomotive testing plant and for such purposes they will not be displaced.

The locomotive testing plant fortunately has placed at our disposal a means for studying the locomotive which has made good the deficiencies of road testing. The first locomotive testing plant was built twenty-one years ago at Purdue University. It was designed by Dr. W. F. M. Goss, who was at that time in charge of the schools of engineering at that institution. Everyone interested in locomotive engineering knows of the epoch making record of that plant and is familiar with the voluminous and illuminating information developed there by Dr. Goss during his connection with Purdue Unversity and in later years by Dean C. H. Benjamin and Professor L. E. Endsley. The work of this laboratory, during its twenty years of operation, has continually given us original and timely information concerning all phases of locomotive performance, which has had a most significant influence on locomotive design both in this country and abroad, and which will always stand to the great credit of this educational institution.

The meeting was largely attended, and much interest was manifested in the subject so ably handled by Professor Schmidt.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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On the Railroads in the Flooded Districts

It has been our pleasant privilege and delightful duty to record the progress made in railroad development and to present scenes of interest, more particularly in our opening pages, illustrating the triumph of railroad engineering in the great work of opening up new pathways of commerce and enlarging the dominion of civilization, and bringing, as it was to be overtaken in the catastrophe, the story has its bright side, and gathers lustre as triumph succeeds trial.

The daily press has presented the facts with a degree of fulness that leaves little further to be desired, but it may be repeated briefly that the damage to the railroads in several of the Eastern and Middle States was without precedent in portation service was demoralized temporarily, and it was only through the resourcefulness of present-day railroad management—which was put to the supreme test in meeting the emergency—that made it possible to restore service on something like regular schedules within two weeks after the high water had reached its crest.

FREIGHT YARDS OF THE PENNSYLVANIA RAILROAD DURING THE FLOOD, YOUNGSTOWN, OHIO.
Photograph, Underwood & Underwood, New York.

it were, the far ends of our great continent together. We are well aware that these brief sketches have been appreciated by our readers, and in referring to the disasters that have befallen many of the railroads in the recent floods, although the story is darkened by calamaties calculated to discourage those whose fortune the history of transportation service. Never before has there been so complete an interruption to commerce between the East and West. Without exception, all of the railroads in the flooded districts were badly damaged, especially where the tracks were in proximity to the overflowing rivers and smaller streams. Trans-

The principal flooded sections embraced, generally speaking, that portion of the country between the Mississippi Valley and the Allegheny Mountains, and all of the territory contiguous to the Ohio, Big Miami, Little Miami, Scioto, Mad, Wabash, White, Cuyahoga, Allegheny and Monongahela rivers, beside countless

smaller streams. To these may be added the Mohawk and a portion of the Hudson river with its tributaries, which fortunately found a ready outlet for its overflowing waters in the near Atlantic. In the Middle States the relief is slow, the level valley of the Mississippi with the mighty river narrowing as it approaches the Gulf of Mexico, forming a limited and therefore a slow means of outlet to the accumulated wilderness of waters.

VIEW FROM THE POST OFFICE AT ALBANY, N. Y., DURING THE RECENT FLOODING OF THE HUDSON RIVER.
Photograph, Underwood & Underwood, New York.

Nearly all of the streams that we have referred to overflowed and swept everything in their paths, with the result that there was a complete cessation of business. Railroad tracks, sidings, heavy bridges of steel concrete and stone construction; stations, shops and terminal buildings, equipment, lumber and costly materials of every sort were carried off by the torrents; and interlocking machinery, signal apparatus, telegraph lines and other property shared a similar fate.

The restoration of the railroad lines so that they could again handle passenger and freight traffic called for the adoption of heroic measures. Famine threatened millions of people in the stricken States where homes had been lost in the floods and whose means of livelihood had been cut-off; therefore, the first efforts of the railroad were directed towards relief work. As soon as temporary service had been restored, whether by direct or indirect connections with the sections devastated by the storms, hundreds of carloads of food, clothing, medicine and other donations were rushed to the relief. Government and State troops were also taken in to maintain order.

In repairing the damage the railroads proceeded as if they were one system. The stretches of track which had escaped the trouble were used jointly by the various roads in the localities, for detouring repair gangs and operating trains as best they could with conditions as they were. It was a hard task owing to the severance of telegraph and telephone communication that made it impossible to obtain accurate knowledge either as to the extent of the destruction or its nature. Much of the information, necessarily, came by way of carriers.

It would be difficult to present details of the losses to the various railroads affected by the floods, but among others the Baltimore & Ohio system already furnish accounts amounting to almost three million dollars. The company's lines west of the Ohio river were situated in the sections where the storm was most severe. Twelve bridges were carried away, and the natural conditions of flood in Northern Ohio were intensified by the breaking of reservoirs, lakes and canals which added renewed force to the flood of waters. At Zanesville the terminals were practically destroyed, including the shops, freight station and other terminal buildings. Damage almost equally great occurred at other points, a remarkable feature of the flood being that in some districts the water not only rose suddenly but rushed with amazing fury, resembling in many districts the Atlantic ocean in a storm. This was owing to the severe wind storms accompanying the flood, together with the terrific downpour of rain. At some points the previous records of high water mark were exceeded by 5 feet, the highest point recorded being at Parkersburg, where 50 ft. 9 in. was recorded.

The loss to the railroads has been very great and the work of restoring the properties to their former condition will extend over a great share of the summer.

Almost every railroad in the Middle West felt the effects of the storm in some manner. Every day sees the schedules brought more and more nearly up to normal. The admirable efforts which the railroads have made and are still making to overcome the effects of the disaster cannot fail to meet the warm commendation of the general public.

THE MEETING OF THE WATERS AT DAYTON, OHIO, DURING THE RECENT FLOODS.
Photograph, Underwood & Underwood, New York.

Double-Tracking the Erie Railroad

Perhaps one of the largest pieces of railroad reconstruction work that has ever been done in the world is that which has been going on on the Erie railroad for several years and which bids fair to be completed during the present year. It embraces two hundred and sixty miles of second and third track on its lines west of Salamanca, N. Y., and on its completion the line from New York to Chicago will not only be double tracked, but three and four tracks will be available for service in the territories having the heaviest traffic.

ONE OF THE FORTY-EIGHT STEAM SHOVELS AT WORK ON THE NEW EASTBOUND DOUBLE TRACK. WESTBOUND TRACK NOT DISTURBED.

The Erie, having been almost the first railway of any magnitude put under construction in the world, the builders had to learn the business as the organization and the work developed; a feat accomplished at the expense of many serious blunders and expensive mistakes, in location and in construction. The purpose of the first promoters of the Erie Railroad was to construct a railroad from the Atlantic seaboard to Lake Erie, where a great shipping port would form an entreport from which the merchandise brought thither by the railroad would be distributed by water into the vast settling regions of the West and Southwest.

Dunkirk was to form the nucleus of this port and the railroad was built to that point. The lakes were at first considered sufficient to transport the freight brought to Dunkirk, but a few years' experience proved that water routes were useless in winter, so the Erie Railroad began to look for western connections. There had been constructed near Buffalo a series of fragmentary local railroads, such as the Erie & Northeastern; the Buffalo & Erie; the Cleveland, Painsville & Ashtabula; Buffalo, Corry & Pittsburgh; Dunkirk, Warren & Pittsburgh; Lake Shore & Michigan Southern, etc.

Under the name of the Lake Shore & Michigan Southern, consolidations were formed that established a through unbroken route from Buffalo to Chicago. This company, the Lake Shore & Michigan Southern, willingly accepted all the westbound business the Erie could offer at Dunkirk, and the arrangement of business interchange was for a time highly satisfactory; but after a few years the Vanderbilt interests secured control of the Lake Shore, which again deprived the Erie of its western connections.

In the highly productive country that lies between the point on the Alleghany river, where the Erie Railroad turns at Salamanca towards Dunkirk, there are many prosperous places that were willing to help in providing themselves with railroad facilities. Between Salamanca and Marion, O., there were four or five short lines which were joined together and called the Atlantic & Great Western Railroad by James McHenry, a British capitalist, in 1863. In 1874 the Atlantic & Great Western became part of the Erie and ever since has formed the main line between Salamanca and Marion.

The fragments of railroad track that afterwards formed the Atlantic & Great Western, were built to sell and built as cheaply as possible, which put the Erie Railroad Company at a disadvantage in competing with other railroads. Minor improvements in the way of straightening curves and cutting down of grades have been carried out spasmodically as funds were available; but recently the work was undertaken with much grasp and energy, as shown in our illustrations.

The reconstruction of so large a section of the road has a double purpose which not only makes it possible to afford facilities for the rapidly increasing volume of traffic, but the complete reduction of the numerous grades to a minimum will make the reconstructed railroad literally a water level roadway, and thereby greatly lessen the tractive power necessary to negotiate the steep grades that existed in many localities. The result will be not only a large increase in the capacity for traffic, but also a marked improvement in the capacity for speed, both of these important changes coming into immediate possibility before the end of the present year.

Some idea of the magnitude of the undertaking may be arrived at when it is stated that the work is in many respects much larger than that which is being carried on in the Panama Canal. None of the cuts are as deep as that at Culebra, but they are many times longer. An unusual feature in such work is the fact that in many sections of the road an entirely new line is being constructed to accommodate the traffic in one direction, while the older tracks will remain to ac-

IT TAKES A MILLION YARDS OF MATERIAL TO MAKE THIS FILL, THREE MILES LONG, FOR THE EASTBOUND DOUBLE TRACK.

commodate the traffic in the opposite direction. In some parts the new double track line is as much as 3,000 feet distant from the old track. In some portions the two tracks run for a considerable distance parallel to each other, the variation being that one line runs along the base of a hill, while the other is along an elevated terrace at a much higher level. Again the tracks cross each other at different levels as if they were rival roads. In other portions the old track is entirely abandoned, and new low-grade double tracks take the place of the present single track line. Occasionally a deep sag in the old line is replaced by the new double line filled in over the valley, so that the new road is seemingly perfectly level.

During the progress of the work the elimination of grade crossings has been carried on, and in every instance the reduction of grade will increase the ton haul capacity occasionally as much as two hundred per cent. In the course of the operations no less than forty-eight steam shovels have been in operation, each excavating an average of thirty thousand cubic yards of material per month in taking out the humps for the new low grade line which is designed for the eastbound traffic. Some of the depressions in the location of the eastbound track have taken over a million yards of material to fill, and in one location the fill is over three miles in length.

Of the rock work encountered it has been in every instance far below the grade of the present line, so that while the cost has been enormous the advantage will be correspondingly great. Some very interesting situations present themselves as valleys are crossed above bridges of the old line, the new and old bridges having no relation to each other further than their nearness, and separating into new directions, as if they had not a common destination.

The accompanying illustrations give some idea of the magnitude of the work, and it is gratifying to learn that during the prosecution of the great undertaking the almost complete absence of serious accidents of any kind has been remarkable in view of the difficulties encountered and the variety of the appliances necessarily in use. Safety first seems to have been the motto, and the management are to be congratulated on the marked success of the undertaking so far, and the prospect of a speedy and safe conclusion of the great task.

ROCK WORK FOR NEW DOUBLE TRACK LINE, BELOW GRADE OF THE PRESENT LINE, WHICH IS TO BE ABANDONED.

South African Railways.

From notes contributed to the Engineering Supplement of the London *Times* we learn that in order to enable the country districts to be placed in regular communication with the railways the Administration has been considering a scheme for the establishment of a road transport service to be worked by two types of motor vehicles, one for passengers, parcels and mails, with a speed of 12 to 20 miles per hour, and the other for goods traffic, with a speed of 6 to 15 miles per hour. The routes would be provided with telephone communication, and the services, which would be conducted in accordance with railway methods, would be replaced by branch railways as soon as the traffic had developed sufficiently to justify such a step.

In referring to rolling stock, it is stated that the yearly requirements for renewals alone will amount to 60 engines, 80 coaches, and 560 wagons, and during the first nine months of 1912 authority was given to provide 96 coaches, 12 dining cars, and 10 baggage and brake vans for passenger service, as well as 418 wagons, 12 refrigerator cars, 8 tank wagons, 35 brake vans, and 124 cattle trucks for freight purposes. As far as possible this stock will be built in the South African railway shops. The results obtained with the two engines constructed at Durban have demonstrated that the policy of building locomotives and boilers in the shops at that town and at Salt River should be developed further as soon as the shops have been enlarged, and schemes have been put forward for the improvement of the plant.

It is considered that the advantages to be gained by the ability to run mineral trains at high speeds do not compensate for the increased cost of maintaining the permanent way, and it would seem to be more desirable to develop a type of engine having great tractive force and a comparatively low speed. Tests have shown the utility of mechanical stokers for locomotives, and the use of these appliances will become more necessary as the size and power of the locomotives increase. Further experiments are being carried out with a stoker which is an advance on the types which have been tried previously, but further improvements will be required before the apparatus can be said to be of practical value. Experiments are also being made with telephones in place of the telegraph for railway working, and it will probably be necessary to appoint a special committee to consider the provision of a suitable automatic coupler for the goods stock.

Locomotives in New York State.

The annual report of the Public Service Commission for the Second district of New York shows that the number of locomotives owned by the railroads which operate wholly, on in part, in the state of New York, increased 4.6 per cent. in the five years from 1907 to 1912. The average tractive effort increased 17.1 per cent., and in 1912 was 30,200 lbs. In the same report an analysis is given of the causes of engine failures, and it is shown that hot bearings are responsible for 12.5 per cent., low steam for 15 per cent., steam leaks for 19.9 per cent., broken machinery for 19.5 per cent., miscellaneous, such as loose nuts, bolts, tires, wheels, burst air hose, etc., for 33.1 per cent. The New York Central & Hudson River had a locomotive mileage of 6,928 miles per engine failure during 1912. This includes all types of locomotives. The Delaware & Hudson had a mileage of 6,250 miles per engine failure. The report states that there have been no boiler explosions proper within the state in the five years during which the commission has supervised this work, notwithstanding the fact that there are over 6,000 locomotives constantly in use within the state and a large number additional in service a portion of the time. It is shown that the average age of boilers on the 9,201 locomotives recorded is 10.15 years.

The most gratifying part of the report is the almost complete absence of serious accidents, and reflects greatly to the ability of the management and skill of the employees.

General Correspondence

Portable Jig for Use in Applying Convex Headlight Protector Glasses.

Editor:

Convex protector glasses used in connection with arc houses of locomotives equipped with the electric headlight present a most difficult and tedious piece of work in applying them to the door-rim when the same is attached to the house, in many cases high upon the engine. This difficulty arises because of the numerous lugs, vibration strips, expander and holder rings that are a part of the method used to hold the glass in place.

In case the rim is removed from the house and laid upon a bench, the convex shape of the glass still presents a feature that is annoying because of the construction of the rim, in most cases built to allow the glass to drop down into it.

Fig. 1 is a sketch of a light and portable stand that will alleviate every difficulty experienced while working with these glasses because of their convexity and the construction of the rim.

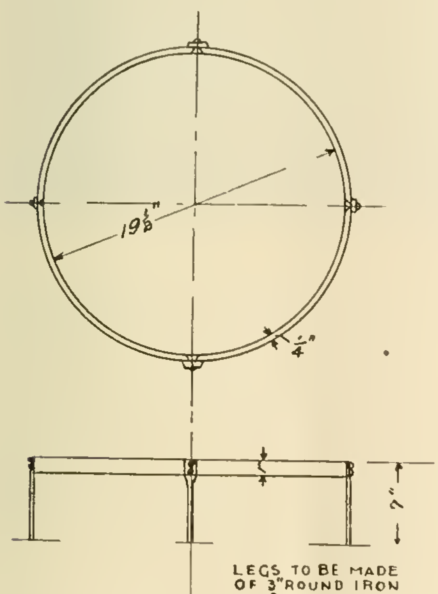


Fig. 1.

The door rim drops down into the band of the stand which securely holds it. The small legs keep the point of convexity on the glass from touching the floor or bench and also allows enough space for placing the hand under it to shift the glass while applying the vibration strips, lugs, etc. With the rim held in this manner, the application of one of these glasses takes up but a very small amount of time, and at the same time the device eliminates all danger of breakage to the expensive convex glasses.

F. W. Bentley, Jr.

Huron, S. Dak.

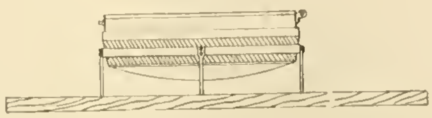


Fig 2

Clamping of Air Brake Pipes.

Editor:

In these days of efficiency tests, etc., how many air brake men realize (at least the men realize it that maintains the equipment in the engine houses and yards) that most failures and detentions charged to air brake failures are caused by broken pipes and fittings. I have never seen an engine that could be called properly clamped. I was looking a new one over the other day to see if it was clamped any better than the last one turned over to us new and was told that the pipes were clamped theoretically correct. I say that may be, but practically there are several pipes on that engine that it is only a matter of how many trips they will last without breaking off; for instance, an air pump discharge pipe clamped to a loose running board, or a connection pipe clamped so that the cab bracket sheet will cut it through, or a cast iron clamp on a cast iron steam valve, that if the man does his work correctly and tightens bolts he can see the bolts' holes break out as soon as the steam is turned on by expansion. I worked in a large railroad shop some years ago changing the equipment on the coaches from the plain triple valve to the quick action. A seven-ton jack was one of the essential tools of the pipe gang. The nipples were all cut standard and they did not have any trouble coupling the train pipe at the triple, but the next season we had the trouble making repairs to them that had not been changed at other points. The improved H. 6 brake valve bracket, with the feed valve attached, similar to G. 6, is certainly a wonderful improvement, it doing away with 15 ft. of pipe and clamps galore. We are also changing the straight air or reducing valve from the back board of the cab. I believe every Pacific type engine in service has a record of one or more detentions caused by this pipe or connection breaking, and here we are again about the clamps. I have seen 14 taken off when the changes were made, but, the cab back board being loose and vibrating, the job would have lasted as long without a clamp. The length of detention depended on the engineman's knowledge of the air brake art

Who has not seen the engineers report equal discharge valve don't seat when brake valve is on lap and found the equal rest pipe leakings, or discharge brakes won't stay on without application and found applicable cylinder pipe broken off, or signal whistle blows all the time and found a union partly uncoupled in signal line, not the fault of the equipment proper but generally the fault of no clamps? I must stop writing, but could go on indefinitely. I believe if the pipe work and clamps were done properly, particularly on locomotives in the back shops, before the engines are put in service, air brake failures and detentions would be reduced to a minimum. Sketch of broken pipes would often tell a tale if they showed how many threads of the pipe were in the fitting, but who has ever seen a sketch to show that? They might as well hectograph a whole lot and just put engine numbers on as failures occurred.

G. D. Haley.

Altoona, Pa.

Coal Supply.

Editor:

The largest expense that a railway has to meet is labor and coal. One of our largest railways went to the expense of sending a car over its lines with demonstrators to teach its enginemen the component parts of fuel and how to properly save a pound of coal now and then. This was a good move and most of the men were interested, as they realize that while they can individually save a few pounds of coal they know that under existing conditions that credit will not be given them, as there is a greater loss which occurs beyond their control that their saving is lost and cannot be found. The method of purchasing coal by the pound is not a good one, as the value of a pound of coal is in the number of heat units it contains. In the present we buy our coal at, say, \$2 per ton on the tender, and each pound of coal is to contain 14,000 heat units, we should have 28,000,000 heat units for our \$2, but we must take into consideration that the coal we buy does not contain

the 14,000 and, of course, the cost per heat unit has thus been increased and in using these figures we are assuming that every pound of coal billed from the mines for locomotive use reaches the tender, and is weighed and charged accurately. We know that there are thousands of small fires burning from the coal intended for the locomotive and this loss is charged to the locomotive. This item still further increases the cost of our heat unit. We will now follow up with a look at how this is handled in order to place it on the tender. It leaves the mine a ton of 2,000 lbs. and the American tourist takes some for his comfort, then the caboose must have its supply, each track and bridge outfit along the route must get their supply, then comes the switch shanties and the outside pilferers, finally it lands at the distributing point where each tender gets its supply, and according to the billing is still a 2,000-lb. ton. Now, we must commence to guess in order to make returns for the amount as it left the mine, and the engines receiving coal at this point have to account for all. Then we get out a fuel performance sheet to show how many pounds of coal it takes to move one ton one mile. How can we get an accurate account when we base our figures on such an insecure foundation. When we started to figure the cost of the heat unit we had to assume that each pound contained 14,000 and that we were getting 28,000,000 heat units for our $2, but from that on we were getting deeper into the dark, and if some one does not show us a light we will go on running around in circles, and the end will be a guessing contest and a farce. If we wish to make a start towards getting out of the darkness, suppose we weigh the coal at the point where we distribute it to the tenders and get the difference in weight at the mine and charge the loss to the source causing it. Then make a test to learn the amount of heat units contained in the coal we are using, then weigh it to the tender and we have an excellent start toward an accurate cost per ton per mile. Should our coal of one kind contain 7,000 heat units then we only get 14,000,000 heat units for our $2, which makes this coal cost $4, as compared to coal that contained the 14,000 heat units per pound, and as there is about 45 per cent. loss in heat units in converting the heat into energy we run up against another increase in cost.

If our coal was purchased with regard to the heat unit its value per ton would depend upon the number of heat units it contained and by this method we would get the proper start towards the solution of this item of expense. There is but one thing to be considered in getting at the true foundation of what earns the money for the railroad and that is the car wheels and they do not earn anything except when in motion. It will be necessary to consider the source, and that is power, and as heat is the source of all power it stands us in hand to make that our starting point. To do so we must buy our coal with regard to quality and keep in mind the fact that all else connected with a railroad is auxiliary to the principle.

GEO. E. HOLTZ.

South Bend, Wash.

A Former Prominent Philadelphia Plant.

EDITOR:

The illustration accompanying this article is reproduced from an old magazine published in New York City in 1851, and kindly loaned the writer by J. Snowden Bell, Esq., of that city.

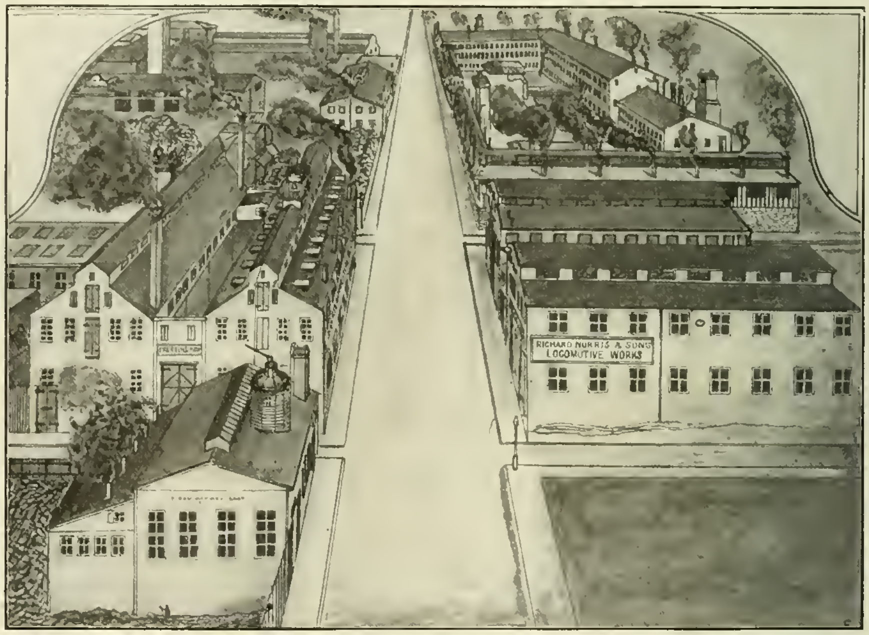
This magazine bore the rather ponderous title of "The United States Magazine of Science, Art, Manufactures, Commerce and Trade," and the engraving was used as a frontispiece, and in connection with an article entitled "The Transportation of Passengers and Wares."

The Norris plant was started among the earliest in the history of American railroading, and under the various firm names of Long & Norris, William Norris, Norris Brothers, and Richard Norris & Son, built many locomotives for both American and foreign railways until 1865, when the shops were closed in Philadelphia and were later purchased by the firm's greatest competitor, the Baldwin Locomotive Works.

Although its existence in Philadelphia was thus terminated, the firm enjoyed a short "renaissance" in Lancaster, Pa., where it leased and operated the old plant of the Lancaster Locomotive Works, formerly conducted by the Brandts.

In this new location the firm was again known as Norris Brothers, and during 1866 and portions of 1865 and 1867 built a number of locomotives for various railways, and then closed the plant, since which time the name of Norris has never appeared among active builders of locomotives.

It might be added that at one time, during the earlier history of the company, it operated a locomotive works at Schenectady, N. Y., which afterward became the well-known Schenectady Locomotive Works, but withdrew from that enterprise, if I am correctly informed, because the financial results were not sufficient to justify carrying it on.



NORRIS LOCOMOTIVE WORKS, PHILADELPHIA, PA., 1851.

The buildings of the Lancaster plant are still standing and now belong to the Pennsylvania Iron Works, Ltd., and in a letter to me of over three years ago, that firm informed me, in answer to an enquiry, that there yet remained in the loft a few patterns of the old locomotive works and very kindly granted me permission to examine them. This I have unfortunately thus far been unable to do. It is just possible that among these patterns may be those of the very peculiar type of cylinder used by Mr. Brandt, in which the steam chest was inclined laterally as well as lengthwise. This pattern was so popular with the mechanical department of the old State Railroad of Pennsylvania that they had Richard Norris & Son use it on four

engines built by them for the Philadelphia & Columbia Railroad in 1856. These engines were "Old Hickory," "Old Dominion," "Hoosier State" and "Washington," known after their sale, with other State property, to the Pennsylvania Railroad in 1857 as Nos. 174, 190, 191 and 192, respectively.

C. H. CARUTHERS.

Philadelphia, Pa.

A Plague-Stricken Railroad in China.

EDITOR:

On the trans-Manchurian section of Russia's great 5,000-mile trans-Asiatic railroad a majority of the track workers are Mongolians. While citizens, nominally, of the new republic of China they are entirely under Russian influence. About two years ago when the plague broke out, it soon reached the Chinese track workers and reduced their numbers so rapidly that it seriously impaired the working of the railway. The Russians also suffered and the State administration of railroads decided on heroic measures. Fire is the best disinfectant, and the Russians burned up the more seriously affected districts, particularly at Karbin, the chief town in Russian-Manchuria.

As the work went on it was found in some smaller places that the entire population had succumbed to the plague. The bodies were gathered in heaps and kerosene poured over them and bodies and village went up in a holocaust. Suspected cases were brought in by railroad to pest-houses specially established and given the best attention possible by the Russian medical corps. The Mongolian authorities did nothing.

The accompanying illustration is selected from a collection of fifty large photogravures sent to us by Dr. Loxbicki of Jalantun, North of Karbin. The type of box car used for the transport of plague victims is the same as is used for the transport of troops and emigrants. Some of the cars were run on to isolated sidings as temporary hospitals, and after the plague was over they were roughly disinfected and brought into service again in troop transport or emigrant use. The Russians never hesitated in burning Mongolian villages, but saved their own rolling stocks.

L. LODIAN.

New York, N. Y.

ON A PLAGUE-STRICKEN RAILROAD IN CHINA.

First Steel Tires.

EDITOR:

It may interest the readers of RAILWAY AND LOCOMOTIVE ENGINEERING to know the circumstances under which the first steel tires were applied to the wheels of a locomotive. The facts are briefly these: In the Fall of 1848, Mr. James Millholland was appointed master mechanic of the Philadelphia and Reading shops at Reading, Pa., and I was engaged by him at blacksmithing. All of the scrap iron from all parts of the road was sent to Reading and sold at that point. There was no demand at all for scrap steel. If some scrap steel got mixed among the iron it was thrown out as being liable to injure the iron if worked with it.

Mr. Warren A. Lewis and his two sons worked at one of the forges and the elder Lewis suggested the possibility of making some use of the steel, and finally got permission to try his experiment during the Saturday half holidays. He soon produced two blooms of the regular size and weight and they were in every respect superior to iron. All of the scrap steel was soon made into the largest possible sizes of blooms and forged into locomotive tires in the company's forge at Reading.

The first set of tires were put on the six-wheel Baldwin locomotive "United States." Immediately afterwards steel tires came rapidly into use, although there was considerable prejudice against them, the common opinion being that they would break easily. The Steelton Manufacturing Company of Nicetown, Philadelphia, in a short time established an extensive industry in making steel tires.

E. J. RAUCH.

New York, N. Y.

Across the Continent with a Locomotive.

EDITOR:

Leaving Philadelphia on December 20, with a locomotive consigned to the Canadian Collieries, Union Bay, British Columbia, we arrived in Portal on February 2, where the thermometer registered 35 below zero. Traveling from here by fast freight to Moose Jaw, from thence to Swift Current, Medicine Hat and Calgary, I was much impressed by the wonderful development of this country since my last visit in 1911. Leaving Calgary, we started to cross the great Canadian Rockies, a description of which is impossible to put into words, so varied and grand is the kaleidoscopic scenery. Passing through the well known beauty spots, Banff and Laggan, where the C. P. R. are building magnificent hostelries, we crossed the Great Divide, at Stephen, and started on downward western slope to the Pacific, arriving at Field, B. C., February 12. Between Field and Revelstoke one passes through some of the roughest kind of country imaginable and one realizes the gigantic difficulties overcome by the C. P. R. when their line was being built. At Rogers Pass I was informed that forty feet of snow had already fallen this year. Leaving Revelstoke we came to Kamloops, the second city of importance in B. C., being the center of the great dry belt, where huge irrigation schemes are under way. From Kamloops to North Bend the line follows the course of the Thompson River, which flows into the Fraser River. One notices the railway construction camps along the opposite side of the river where the C. P. R. are building a double track between Calgary and Vancouver in order to handle their ever increasing amount of traffic. We reached Vancouver on the 16th of February, being now 3,270 miles from Philadelphia. Again, here in Vancouver, one sees the rapid development that the country is now undergoing. It is a city of 150,000 inhabitants. Huge terminals are under construction by the C. P. R. costing

millions of dollars. All kinds of harbor improvements and extension works are being undertaken as a large trade is being developed between Canada, Australia, and the Orient.

The C. P. R. also has a fleet of boats here, plying between Vancouver and Vancouver Island, which lies to the west of the mainland. Here, again, one hears and sees nothing else but development. The island is rich in mines and timber and large, fertile districts ready for agriculture. Last year two million and a half tons of superior coal were mined on the island and the output is ever increasing. Huge saw-mills are springing up in various places and railway construction going on in all directions. One cannot help but realize what a wonderful rich country our Canadian cousins possess, and great opportunities lie before everybody who will only get into line and hustle. The principal city on Vancouver Island is Victoria, which is also the capital city of the Province of British Columbia. This is a well built city with a population of 50,000 inhabitants. It is a favorite residential city, famous for its natural beauty; the temperature rarely goes above 75°, or below freezing. It is the terminal of the Esquimalt and Tranarmo Railway. It is the land of promise and no young man can do better than to direct his steps towards this western country.

One can hardly realize the vastness of the journey that we have just completed, which was covered in 24 days, giving an average mileage of 134 miles per day, which, considering the time of year, is a very fast trip. The distance from Vancouver to Union Bay is about 90 miles. Our engine was run on to a large transport or barge, and lowered by a powerful tug. Owing to stormy weather we were three days covering this short distance. It being necessary to seek refuge in-shore on two or three occasions. However, it has been a very interesting and instructive trip, and now the engine having been passed by the boiler inspector and accepted by the Dunsmun Co., the writer is starting to retrace his steps homeward.

Geo. H. Jackson

Turntable Equipment.

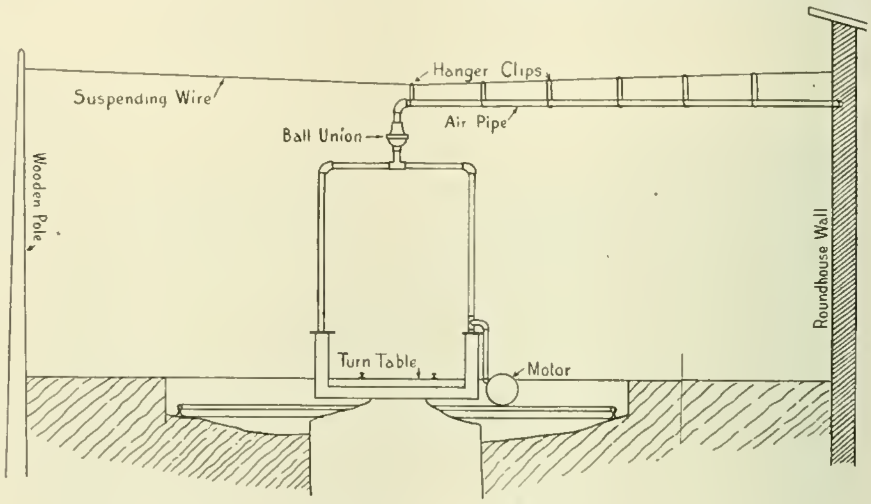
Editor:

It is a well known fact that there are a great many roundhouses in the United States and Canada where the turntables are equipped with very crude and primitive systems of propulsion, the most costly being where a number of men are taken from their regular work and used in moving the turntable to the required position. In others a rubber hose is used in conveying compressed air to drive a motor equipped with means for turning the table. The foremen at such roundhouses are well aware that the hose not only gives much trouble and does not last long, and furthermore the table cannot be completely turned around without twisting and consequently injuring the hose.

The enclosed sketch shows a simple system whereby these troubles may be avoided, and the cost of the construction of the same would be insignificant. The system shown is in operation and no kind of trouble has been experienced. The system by examining the annexed drawing is self-explanatory, and wherever compressed air is available the construction of the appliance would pay for itself in a short time.

J. G. Koppell

Montreal, Canada.



TURNTABLE EQUIPMENT.

Cylinder and Valve Lubrication.

Editor:

In reading James Spellen's article on "Lubrication of Superheated Locomotives," I cannot agree with him. I do know you cannot get the best results from any large engine whether it is superheated or not by drifting with a close throttle, not alone in lubricating cylinders and valves, but it is also harder on your rods and boxes. And have you not noticed, if you close the throttle for a short distance how your engine pounded and you had all your wedges and rods keyed up properly?

I do not think that the relief valves are all so much to blame for admitting air to the cylinders (except in cold weather) if they were large enough to supply all the air, which they are not; but the air is drawn in through your exhaust passages and with it some fine cinders, and it is this which raises all the trouble in your lubrication with a closed throttle drifting.

It is not the amount of oil you give but getting it to the right place at the right time. You can take an engine which has been properly lubricated and should your lubricator go dry, you can run from twenty to thirty miles before your lever will begin to tell its tale of woe.

I have shut off for a distance of probably one thousand feet before coming to a stop at the bottom of a hill and the engine would start to groan when I started up again, so I do not shut throttle off tight, but leave cracked until engine comes to a full stop, whether drifting down hill, switch, station or water plug; and when stopped, set your straight-air on engine if N. Y. equipment or E. T., and open your cylinder corks, and you will also find this easier on your draft rigging and there will not be any shocks in your train and your train will be easier to start without jerking, and this on a hilly division and, of course, you have to carry the water properly.

Now as to the little amount more of coal you burn, it can be made up in going up the hill by gradually losing water and keeping a bright fire down hill and filling your boiler up easier in flues and firebox.

There is another thing they say, piston is the engineer valve, and slide valve the company valve, which is not borne out in practice. If a piston valve is not properly lubricated, beware of the front window, if you are not braced before you unlatch lever. A piston valve will tell you just as quick as a slide valve when she is short on oil.

I have ridden on superheated engines in fast passenger service with 24 by 30 inch cylinders 4-6 type which were using special valve oil and the reverse lever was trying to get out the front window for the want of a few drops of oil, by shutting throttle off a minute, this on runs of 40 to 50 miles between stops and this where making over 150 miles to a pint.

I have had the best results in lubricating cylinders and valves by getting my lubricator working from 15 to 30 minutes before starting and by giving each cylinder a spoonful of graphite at the beginning of each trip, this in fast freight service with engines carrying 200 pounds pressure. You can take reverse lever in any position and hold it with one hand. We are allowed three pints of valve oil for two hundred miles, and beside, engine handles her tonnage easier on herself and coal-pile and does not need to find the company notch on the hill.

C. F. Sundberg.

Sioux City, Iowa.

Old-Time Railroad Reminiscences.

By S. J. Kidder.

I wonder, Mr. Editor, if you ever was so unfortunate as to get a good job running an engine at the expense of throwing up a better one.

Well, that's what befell the writer way back in '73, as a result of stopping over in Rochester, N. Y., for a visit of a few days with some of his old friends running on the New York Central between Rochester and Buffalo, at that time a division of the road. Among my acquaintances were George Lingham and Ben Brown, both old engineers on the road, and who were responsible for the dilemma in which I later found myself. It may be said that in those old days a prospective employee was not subjected to the physical, mental, moral and other inquisitorial formulas so rigorously enforced at the present time as under the old regime. A letter of recommendation from a former employer or a good word from an engineer on the road and a satisfactory personal appearance was all the master mechanic desired in the way of "character" when the requirements of his department demanded reinforcement. Unbeknown to myself, the friends above mentioned had entered into a conspiracy to get me a job on the road, and when one of them introduced me to the master mechanic with the remark, after depicting my good qualities as an engineer, that I wanted a position, I was too much astonished to deny the allegation. "Well," said the master mechanic, "we don't need any men just now, but if I send for you will you come?" "Yes," I replied, but when a few days later, I had reached Iowa the agreement had been dismissed from my mind to the extent that I had no thought of it being referred to again. Some six months elapsed, when I was disagreeably surprised to receive a letter asking me to come at once, the tone of the letter indicating that the master mechanic had taken me at my word with no question in his mind but that I would gladly avail myself of the opportunity to accept his offer. To give up a fine, highly embellished engine thoroughly cleaned at each end of the run and the best passenger train on the division, to run engines of most sombre hue from which, other than the guides and links, the dirt and oil was removed only when the engine went into the shop for an overhauling was a proposition anything other than inviting. However, something must be done, so after thinking it over, the master mechanic was advised by return mail that I could not come at once, as a six weeks' notice would have to be worked out. This delay, it was assumed, would close the negotiations, but a prompt reply was received to the effect that six weeks would be perfectly satisfactory, and I could report at that time. This left me destitute of further excuses, and when the time limit expired my few belongings were packed up, and with no elation over the new job I proceeded to Rochester. In 1873 the New York Central was one of the longest and oldest railroads in the country, its double track stretching entirely across the State, and I naturally inferred that, as compared to the new single track pioneer lines of the West, with which I was familiar, the Central must be far advanced in methods of operation, discipline, etc., but, as will be pointed out later, a short season in its service and with opportunities for observation, was sufficient to make clear that in no small degree these impressions were mistaken ones. Commodore Vanderbilt, the president, was then building two additional tracks which, according to the alleged assertions of the Commodore, would put the Erie Canal, which parallels the railroad, out of business to the extent that in a few years grass would be growing in its bottom, but while he poured water plentifully into the stock of the railroad in an endeavor to accomplish this with his four-track system, the real article continued to placidly flow over the to be verdured canal bed.

During my sojourn on the New York Central the motive power, rolling stock and length and weight of trains were but pigmies as compared to those of the present day. With the exception of a small number of Detroits, all the engines of the road were Schenectadys, more familiarly known as McQueens, the largest having 17 x 24 in. cylinders, and weighing some 40 to 45 tons. All of the more modern engines were of very similar design, the freight engines having five fast driving wheels; the passenger engines being some six inches larger. Many of these engines had originally been profusely decorated with brass trimmings, the cylinder, steam chests, dome, sand box, hand rails, wheel guards, etc., also numerous brass acorns, but when a very dark colored paint was selected for standard, this road being the first to adopt that color, it was applied to the brass as well as to the other portions of the engine, from the rails to the top of the smokestack. Employment as an engineer on the New York Central was a pretty good job, the rate of pay being $3.50 a day, work or play. A single trip between Rochester and Buffalo, 69 miles, constituted a day's work, and for a round trip, one and a half days was allowed, or $5.25. A single trip from Rochester to Niagara Falls, 77 miles, was also on the one-day basis, and one and three-fourths days, $6.12½, for a round trip.

Passenger engines doubled the road five days per week; no trains were run on Sunday, and one week day was allowed for washing out and doing work on the engine, the engineer for these two lay-in days receiving the day rate of pay. Freight engineers received the same rate of pay as those on passenger trains, though no lay-in day was assigned them, as freight engines ran first in first out. Each engineer, in a book provided for the purpose by the railroad, kept his own time and that of the fireman, turning the book in to the master mechanic's office once each month that the time might be transferred to the pay roll.

A man entering the service of the company was permitted to take all the time he pleased to learn the road, being free to ride on this or that engine as he chose, and his time was recorded in the book of whatever engineer he happened to ride with. All of the employees were paid in cash from a pay car, which had a regular schedule for its monthly trips, and everyone received his pay at the appointed time, providing the paymaster did not digress for a few days on a fishing trip to Lake Ontario, in which event the payment of the board bills and other obligations had to be stood off until the paymaster again resumed his regular official duties. Sometimes it seemed as if the greenbacks as they came through the wicket were in quantity rather than quality, as it was by no means unusual to receive a month's pay, $150, more or less, all in two-dollar bills. All engineers, excepting the extra ones, had regular engines with runs of a character that seldom required a lay off for rest, and as a consequence the extra man, with his pay going on as regularly as a swinging pendulum, had both a lazy and an easy job. He seldom was called upon to make more than one or two round trips per week and while hanging round his only duty was to report at the roundhouse twice daily, 8 a. m. and 5 p. m., the hours when the engineers and run were marked upon the blackboard. If his name did not appear it was evident he would not be needed before another filling out of the board, though subject to a call by notice at any time.

Two kinds of coal was supplied, Beaver mine for passenger and Blossburg for freight engines. The Beaver mine coal had exceptional steaming qualities, an important factor in getting the fast and heavy passenger trains over the division on time with engines of somewhat limited steam generating capacity when fired with fuel of an inferior grade.

No efforts in the way of oil economy were apparent, it being so extravagantly used that at the tanks where all engines stopped for water the road bed was saturated to the extent that numerous puddles of oil were always to be found between the rails and ties. In running engines with which one is not familiar, oil is generally used with considerable freedom, but when I covered the 69-mile division with the use of from two to three pints of engine oil, some of the regular

firemen marveled that I dared run the engine with so little lubrication. One old inside-connected McQueen, whose mission was to haul a construction train, had hook motion valve gear. One day as the engine stood between the roundhouse and turntable, a group of engineers began discussing the valve gear. Then one after another made an attempt to back her into the house, but the best they could do was to move the engine a few feet one way or the other. Finally one of the men got the gear in forward working position, and after starting could not stop, with the result that a moment later the engine was ungracefully reposing in the turntable pit.

Shock-Absorbing Platform for Railway Cars.

An improved system of construction for protecting the ends of a railroad-car body in collisions and wrecks has been designed by a resident of Ohio. The construction is such that, in case of a severe shock, the platform and vestibule will collapse, forming a cushion space of almost 8 ft. between two cars, before the car bodies come together. In a train containing eight coaches this space would be more than 50 ft. of cushion construction, or, it is claimed, sufficient to absorb the shock and consequent damage before the cars containing the passengers could be seriously disturbed. This result is accomplished by fastening extension platforms to the center sills of the car body with rivets in such manner that these will shear when the car receives a shock of unusual severity. The steps, vestibule doors and hood will also collapse when the rivets shear, thus tending to further absorb the force of the collision. The entire end of the car body is covered with a heavy steel plate which extends from the upper portion of the roof to the bottom of the end sill; this plate being provided for further strengthening the end of the car body, to hold the end posts in position and prevent parts of the vestibule from piercing the end of the car. The entire platform, vestibule, hood and sill extensions are made in one piece and may be attached to the car at any time after it is built.

Flood Losses.

Barney & Smith, car builders of Dayton, O., have been tremendous sufferers from the floods. The estimated loss is $3,000,000. There were in the works twenty-nine finished sleeping cars that were ruined.

The insane movement calling for sanitary drinking cups in railway trains originated in Kansas, where so many other idiotic ideas have been converted into foolish laws.

New 10-Wheel Type of British Locomotive

A series of four-cylinder simple 4-6-0 Express locomotives are being built at the Crewe works, the first one of which "Sir Gilbert Claughton" has just made its appearance. Designed by Mr. C. J. Bowen Cooke, the chief mechanical engineer, these engines are intended for working the heavy main line expresses.

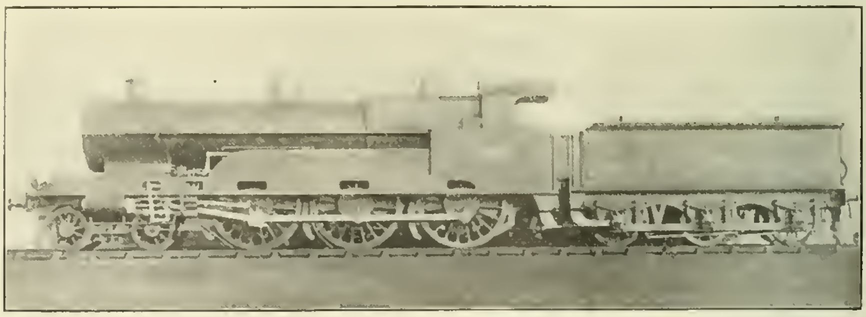
The four cylinders are 16 ins. in diameter by 20-in. stroke, are all in a line, and drive onto the leading coupled axle. The inside cranks are set at right angles to one another, while the outside cranks are at an angle of 180 degs. to the corresponding inside cranks, and are therefore at an angle of 90 degs. to one another. By this arrangement balancing of the reciprocating parts is obtained. The diameter of the six coupled drivers is 6 ft. 9 ins. and of the four leading truck wheels 3 ft. 3 ins. Walschaerts valve gear is fitted to the outside cylinders, the valves for the inside cylinders being actuated by rocking levers coupled to the outside cylinder valve spindles; so that two sets of motion operate the four inside admission piston valves which control the distribution of steam for each cylinder. The piston valves are 8 ins. in diameter. A good feature of the engine is its large boiler, which has a maximum diameter of 5 ft. 2 ins. and is 14 ft. 6 ins. long; the firebox is 9 ft. 5 ins. long and 4 ft. 1 in. wide outside; 159 tubes of 1⅞-in. diameter provide a heating surface of 1,160.9 sq. ft., and the Belpaire firebox gives 171.2 sq. ft., while the 24 large tubes for the superheater elements furnish 486.3 sq. ft., making a total of 1,818.4 sq. ft.

Schmidt's superheater, which has been adopted as standard by the L. & N. W., has been applied to this engine. There are 24 tubes with a heating surface of 413.6 sq. ft. The boiler pressure is 175 pounds. per sq. in. The extended smokebox is 6 ft. 2 ins. long. The fire grate is 8 ft. 9 ins. long, and slopes downward towards the front for about two-thirds of its length. The grate area is 30.5 sq. ft. There are four narrow elongated windows in the front of the cab.

Two injectors are fitted, one being of the ordinary "Crewe" pattern, and the other an exhaust steam injector. Other special equipment includes Wakefield's mechanical lubricator. Vacuum brake is fitted to both engine and tender, and compensated brake gear with the tender blocks operating on the back of the wheels.

The tender carries 3,000 gallons of water and six tons of coal. Engine and tender complete weigh 116 tons, and the over-all length is 63 ft. 4¾ ins., the wheelbase being 54 ft. The weight on the driving wheels is 57 tons.

The engine is named after the chairman of the L. & N. W. Company, Sir Gilbert Claughton, and nine others on order will be called after other directors.



TEN-WHEEL TYPE OF LOCOMOTIVE FOR THE LONDON & NORTHWESTERN RAILWAY OF ENGLAND.

Possibilities of Sawdust.

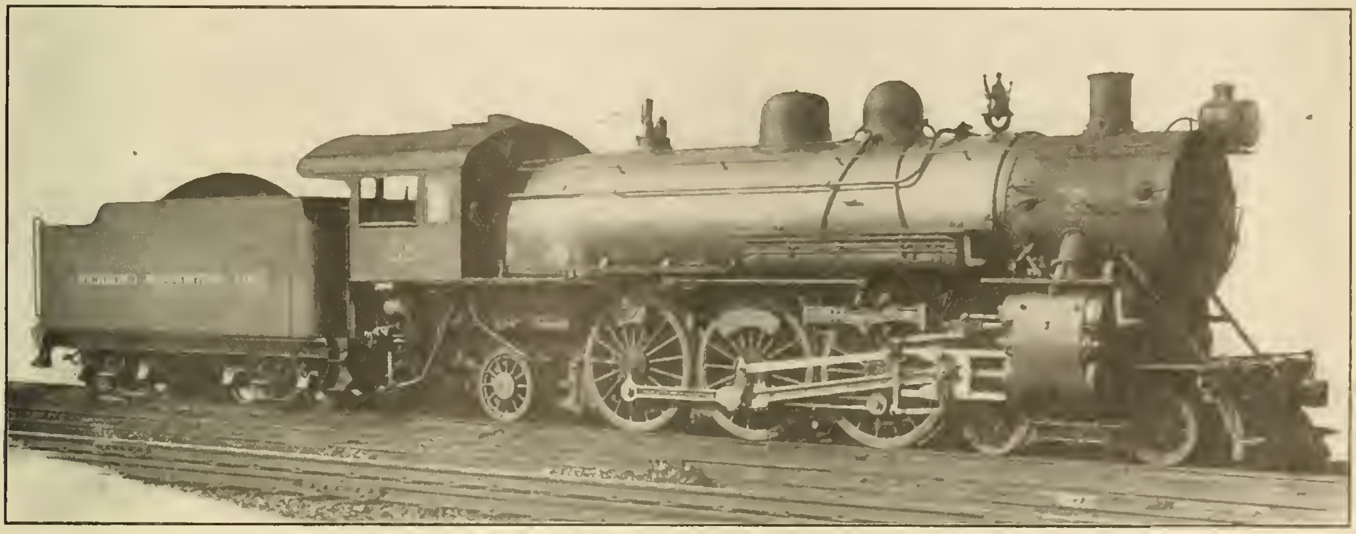
A would-be funny story tells about a foolish carter who tried feeding his horse with sawdust instead of bran, and was surprised that the beast knew the difference. The material difference is that an animal's stomach is not designed to extract the nutriment from sawdust, which contains valuable food elements.

When sawdust is subjected to chemical treatment under heat pressure, it produces about twenty-five per cent. of sacchulose, a species of crude sugar. This cannot yet be refined into crystalline sugar, but it forms a valuable cattle food. There also can be extracted from sawdust acetic acid, methyl-alcohol, and other products, one of them making a cheap base for the manufacture of artificial rubber.

Along the line of the Southern Railway and of the Seaboard Air Line are to be seen at frequent intervals immense heaps of sawdust that are the refuse of abandoned sawmills. Other sawmills not abandoned are still heaping up this wood product that contains fortunes awaiting the enterprise that will convert this valuable material into wealth.

Pacific Type of Locomotive for the Washington Southern R'y.

The Washington Southern Ry. (Richmond-Washington Line) has recently placed in service five superheater Pacific type locomotives which were built by the Baldwin Locomotive Works. Two previous classes of Pacific type locomotives, built in 1904 and 1907 respectively, have been furnished the road by these works. The following table compares the leading dimensions of these three classes, and illustrates the progress that has been made:



4-6-2 TYPE OF LOCOMOTIVE FOR THE WASHINGTON SOUTHERN RAILWAY.

W. F. Kapp, Supt. of Motive Power. Baldwin Locomotive Works, Builders.

Date.	Cylinders.	Drivers.	Steam Pressure.	Grate Area.	Water Evaporating Surface.	Superheating Surface.	Weight on Drivers.	Weight, Total Engine.	Tractive Force.
1904	20 ins. x 26 ins.	68 ins.	200	49.5	2,967	——	116,620	180,560	26,000
1907	22 ins. x 28 ins.	73 ins.	200	49.5	4,107	——	143,750	230,800	31,500
1913	24 ins. x 28 ins.	73 ins.	185	49.5	3,084	709	151,200	240,000	34,800

The new design is a direct development of that of 1907, and a large number of details are interchangeable in the two classes of locomotives. With the introduction of superheated steam, the pressure has been reduced, but the cylinder diameter is increased sufficiently to raise the starting tractive force by 10 per cent. The boiler capacities, on a heating surface basis, are nearly alike. Assuming each square foot of superheating surface of the same value as 1½ square feet of water evaporating surface, the total equivalent heating surface of the new engines becomes 4,147 square feet, as compared with 4,107 square feet in the earlier design. The actual advantage due to the installation of the superheater, should be materially greater than that indicated by the above figures.

These locomotives have straight top boilers, the minimum shell diameter being 74 inches. The firebox is radially stayed, and all the bolts, except those in the crown, are flexible. The superheater is of the Schmidt top-header type, with 28 elements. Superheated steam is conveyed to the steam chests through outside pipes, and the distribution is controlled by 14-inch piston valves. These are driven by Baker gear, and are set with a lead of ¼ in. In order to keep the cylinders moist, provision is made for admitting a small quantity of saturated steam when the locomotive is drifting. The cylinder and steam chest bushings, together with the piston heads and packing rings, are of Hunt-Spiller gun iron. The same material is used for the pedestal shoes and wedges.

The tender has capacity for 7,000 gallons of water and 12 tons of coal. The tender frame is of cast steel, as are also the truck side frames and truck bolsters. The wheels are of forged steel.

The following are the general dimensions:

Track gauge—4 ft., 8½ ins.

Cylinders—24 ins., x 28 ins.

Valves—Balanced Piston.

Boiler—Type, straight; material, steel; diameter, 74 ins.; thickness of sheets, 13/16 ins.; working pressure, 185 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 108 ins.; width, 66 ins.; depth, front, 74 ins.; depth, back, 71 ins.; thickness of sheets, sides, 5/16 ins.; thickness of sheets, back, 5/16 ins.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 4 ins.; sides, 4 ins.; back, 4 ins.

Tubes—Diameter, 5½ ins. and 2¼ ins.; material, 5½ ins., steel; 2¼ ins., iron; thickness, 5½ ins., No. 9 W. G.; 2¼ ins., No. 10 W. G.; number, 5½ ins., 28; 2¼ ins., 166; length, 21 ft.

Heating Surface—Fire box, 196 sq. ft.; tubes, 2,888 sq. ft.; total, 3,084 sq. ft.; grate area, 49.5 sq. ft.

Driving Wheels—Diameter, outside, 73 ins.; diameter, center, 66 ins.; journals, 10 ins. x 12 ins.

Engine Truck Wheels — Diameter, front, 33 ins.; journals, 6 ins. x 10 ins.; diameter, back, 42 ins.; journals, 8 ins. x 12 ins.

Wheel Base—Driving, 12 ft., 10 ins.; rigid, 12 ft., 10 ins.; total engine, 32 ft., 8 ins.; total engine and tender, 64 ft., 1 in.

Weight—On driving wheels, 151,200 lbs.; on truck, front, 48,800 lbs.; on truck, back, 40,000 lbs.; total engine, 240,000 lbs.; total engine and tender, about 375,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7,000 gals.; fuel capacity, 12 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 709 sq. ft.

Filling Holes in Castings.

Defects in castings may be filled with a paste made of 2 lbs. of iron borings, 1¼ lbs. of dextrine and ¾ lb. of litharge, the whole mixture being colored with lampblack to the desired shade. The iron borings should be sifted. After the parts are thoroughly mixed, add enough water to make a paste. This is applied to the defects and blow-holes with a putty knife. When the paste has dried thoroughly, it can be machined just as the metal.

Catechism of Railroad Operation

Questions and Answers.

Second Series.

(*Continued from page* 133.)

Q. 18. What effect would a leaky rubber seated check valve in the emergency cap of the distributing valve have on the operation of the brakes?

A. A leaky rubber seated check valve would not materially affect the operation of the brake except in the event of an over reduction in service or when the brake is used in emergency. In the event of an over reduction the emergency slide valve would uncover port J and allow brake cylinder air to flow into the brake pipe, which might raise the equalizing piston and blow out through the brake pipe exhaust or in emergency out through the direct exhaust at the brake valve.

Q. 19. What effect would a broken application cylinder pipe have on the operation of the brakes, and how should it be treated?

A. When the application cylinder pipe breaks it cuts off all communication between the independent brake valve and the application cylinder; therefore, the brakes cannot be applied or released with the independent brake valve. This, however, does not affect the operation of the brake with the automatic brake valve, providing the broken pipe is plugged up; therefore plug the pipe towards the distributing valve end and operate the brakes with the automatic.

Q. 20. What effect would a broken distributing valve supply pipe have that is the upper pipe on the left?

A. This would render the engine and tender brake inoperative.

Q. 21. What can and should be done in the event of a breakdown of this kind?

A. Ordinarily the broken pipe should be plugged either by turning the cut-out cock or stopping it up in some other manner towards the main drum end and proceed without the engine brakes. In the event, however, of it being absolutely necessary to use the driver brakes, remove the application cylinder cap and application valve cap, take out the application valve and pin, and then remove the application piston; next replace the caps and plug the brake cylinder exhaust; then operate the brakes with the independent brake valve as a straight air valve.

Q. 22. What effect would a broken brake pipe to the distributing valve have on the operation of the brakes?

A. This would prevent the charging of the pressure chamber and would therefore prevent the operation of the brakes of the engine and tender with the automatic brake valve. In order to operate the brakes on the engine, plug the pipe toward the train end, release the brakes with the independent brake valve. When it is desired to set the brakes place the handle of the independent brake valve in application position which will apply the brakes on the engine, the brakes on the train being operated in the usual manner with the automatic. In releasing the brakes the handle of the independent must remain in full release position some little time, as the air from the pressure chamber and application cylinder will have to be exhausted out through the brake valve in order to release the brake.

Q. 23. What effect would a broken brake cylinder pipe have, and when would it be indicated?

A. A broken brake cylinder pipe will usually prevent the applying of a part or all of the brake cylinders, depending upon where the pipe breaks. The attention of the engineer will first be called to a broken brake cylinder pipe in starting to make a stop; this is due to the fact that when running along the road the broken pipe would not affect the air pressure in any manner, but in attempting to apply the brakes as soon as the application piston and slide valve were moved over far enough to make an opening from the main reservoir to the brake cylinder the red hand on the No. 1 gage would commence to fall.

Q. 24. In the event of a broken brake cylinder pipe what should the engineer do in order to make stops without losing his pressure?

A. In order to make the stops without losing time when it is desired to apply the brakes the engineer should hold the handle of the independent brake valve in full release position; this will prevent building up a pressure in the application cylinder. The application piston will, therefore, not move over, and main reservoir air will be prevented from escaping out through the broken pipe. It must be understood, however, that the brakes will not apply on the engine.

Q. 25. What should be done in the event of the main reservoir pipe breaking off near the automatic brake valve?

A. Plug up the ends of the broken pipe as tight as possible, especially the end towards the brake valve, and run with the brake valve in running position. In case the brake pipe pressure raises the rotary valve the handle of the brake valve can be moved from full release position toward running position until the warning port stops blowing. In this position cavity F in the rotary will connect port D, which is the feed valve port, with port B leading to the train line. In this position air from the train line will also pass up through port A in the rotary, preventing the rotary from raising. The brakes must be released from running position; this will also render the excess pressure governor inoperative. The high pressure governor will therefore have to be adjusted to control the pump at the desired pressure.

Q. 26. What should be done if the brake pipe is broken between the engine and tender in such a manner that the air cannot pass through the regular connections to the train?

A. Plug up the broken pipe next the engine. If the engine is equipped with the whistle signal, connect the signal line hose at the pilot to the brake pipe hose, then connect the signal line hose to the train pipe hose on the tender and operate the brakes in this manner. This will prevent the use of the signal equipment on the train.

Q. 27. Suppose the brake pipe was broken between the brake valve and the main brake pipe line; for example, that part of the pipe leading from the brake valve down to the main line, could the brakes be operated on the train by the independent brake valve in the event of a break-down of this kind?

A. There are several ways in which it might be possible to operate the train brakes with the independent brake valve in a real case of emergency. The first method would be to plug up the broken pipe and, in the event of the quick-action cap being used, remove the emergency valve and check valve, cut out the driver brakes and tender, adjust the reducing valve to 70 lbs., then place the handle of the independent brake valve in service position and hold it there. This will maintain 70 lbs. pressure in the application cylinder, which will force the application piston and slide valve over and charge up the brake pipe through the application valve down through port M and up through the quick-action cap to the train line. When it is desired to set the brakes, place the handle of the independent brake valve in release position and reduce the pressure in the application cylinder. The pressure on the opposite side of the piston will force the application piston to release position, opening the exhaust and allowing brake pipe air to flow to the atmosphere, thus applying

the brakes. In order to release the brake again, the handle of the independent brake valve must be placed in application position. The second method, the reducing valve must be adjusted the same as described in the first method, and the independent brake valve operated in the same manner, but instead of charging the brake pipe as described in the first method we will now couple the brake cylinder hose on the engine to the brake pipe hose on the tender and operate the brakes. The driver brakes on the engine must also be cut out and the brakes operated the same as before. It must be understood, however, that this is not recommended for general practice, but is merely a matter of answering the question which the writer has heard frequently asked.

Q. 28. How would you test for leaks in the distributing valve release pipe and determine whether the leak is between the distributing valve and the independent brake valve or between the independent and the automatic brake valve?

A. Apply the brake with the automatic brake valve and place the valve in lap position. If the brake releases while the valve is in this position it denotes a leak in the application cylinder pipe or application cylinder cap. If the brake does not release with the brake valve in this position, then place the independent brake valve in lap position and the automatic in holding position. If the brake then releases there is a leak in the distributing valve release pipe between the independent brake valve and the distributing valve. If the brake does not release with the valves in this position, then place the handle of the independent brake valve in running position. If the brake then releases there is a leak in that portion of the release pipe between the independent and automatic brake valve.

Q. 29. What should be done in the event of a broken reducing valve pipe between the independent brake valve and the reducing valve?

A. Slack off on the adjusting screw of the reducing valve until the valve assumes closed position. This will prevent the loss of main reservoir air. In the event of the rotary valve raising during an automatic application the handle of the independent brake valve can be placed in slow application position. It must be understood, however, that this renders the independent brake valve inoperative, but does not interfere in any way with the automatic operation. This will also prevent the operation of the whistle signal.

Q. 30. What effect would it have on the operation of the brakes in the event of the feed valve pipe breaking between the feed valve and the automatic brake valve?

A. This would cause a reduction in brake pipe pressure and would possibly apply the brakes unless the engineer acted quickly. It would also reduce the pressure above the diaphragm of the excess pressure governor and stop the pump. In order to operate the brakes it will be necessary to slack off on the feed valve until the valve assumes closed position and plug up the end of the feed valve pipe next the brake valve. Also screw down on the excess pressure governor until that governor is out of commission, and adjust the high pressure governor to not more than 90 lbs. or whatever pressure is desired in the train line according to the class of service; then disconnect the distributing valve release pipe between the automatic and independent, and carry the brake valve in release position, when the brakes can be operated successfully. The object in disconnecting the distributing valve release pipe is to prevent any leakage into the application chamber or cylinder, applying the engine brakes, in view of the fact that full release position is a holding position. In the event, however, of it becoming necessary to hold the brakes applied on the engine while releasing the brakes on the train, the independent brake valve can be placed in lap position.

Questions and Answers For Car and Air Brakemen.

Q. 1. With the quick service K triple valves, how is the service application quickened over the application made by the old type H triple valve?

A. In applying the brakes the service applications with the old type quick action triples it was necessary for all the air that was taken out of the brake pipe during the reduction to pass out through the brake pipe exhaust; therefore, in the event of a long train the air had to flow through the entire length of the brake pipe. This caused the application of the brakes to be very slow, as it must be borne in mind that the air from the auxiliary cannot flow into the brake cylinder any faster than the reduction is being made from the brake pipe. On the other hand, when the quick service triple is being used each triple valve throughout the entire length of the train moves to quick service position, thereby venting a portion of brake pipe air into the brake cylinder. For example, suppose we had 50 cars in the train, there would be 50 reductions made from the brake pipe by the triple valve and one at the brake valve, which would mean that 51 reductions had been made instead of one, as with the former triples.

Q. 2. Is there any material difference in the operation of the K triple valves in emergency position over and above the older types of quick action triples?

A. No. The operation of the K triple valve is precisely the same as the quick service feature does not register in emergency position.

Q. 3. In the event of releasing the brakes on a train of cars fitted with the two different kinds of triples, namely the K and the H, what different results will be obtained?

A. The results that will be obtained will no doubt differ to some extent, depending upon the location of the triples in the train as all K triples valves within a radius of 30 cars will in all probability assume retarded release position, while the H triples will move to full release position.; therefore, in the event of a number of H triples valves being placed ahead of the K triple valves it is possible that the slack might have a tendency to run out. The better practice under these conditions would be to come to a full stop before releasing the brakes.

Q. 4. What action of the air is necessary to cause the K triple valves to assume retarded release position, and in what part of the train will this take place and why is it impossible to cause these triples to assume retarded release on a train at the rear end?

A. In order to force the triples to retarded release position, it is necessary that the brake pipe pressure be raised at least three pounds above the pressure in the auxiliary. The reason why this cannot be accomplished at the rear of a train of any considerable length is due to the fact that the friction of the air in the pipe prevents the air from flowing back and causing a sudden raise of brake pipe pressure any farther away from the engine than above 30 cars.

Q. 5. What causes the triple to move to quick service position is in the amount of reduction that is made from the brake pipe or the length of time that it requires to make the reduction that causes these triples to assume quick service position?

A. It is the rate of reduction that causes the triples to assume quick service position, and not the amount of the reduction. On the other hand, it is the volume of air in the brake pipe that regulates the time required to make a given reduction from the brake pipe; therefore, it must be borne in mind that the length of the train determines the volume in the brake pipe as the longer the train the greater is the volume. The opening at the brake valve being the same for long and short trains.

To Clean the Surface of a Whetstone.

The uncovered whetstone soon takes on a gloss from dust particles that collect on it. This smooth, glossy surface can be easily removed by applying powdered pumice to the stone just before using it. This treatment removes the grit, and the knife blade will be polished. At the same time it is quickly ground to a good edge. The powder can be kept ready for use in a face-powder can with a shaker top.

Questions Answered

BLOW IN BY-PASS VALVE.

N. A. B., Essex, Mont., asks.—Is there any way to find a blow for a by-pass valve on a Mallet engine? A. Place the engine on either top or bottom quarter on the side to be tested. Now place reverse lever first in either full gear forward or full gear back; and, with the Baldwin type of locomotive, open the starting valve. With the American type of locomotive, open the main throttle. This will admit steam to one end of the low pressure cylinder. If the by-pass valve at that end is either stuck or broken, it will allow part of the steam to pass through the by-pass valve into the other end of the cylinder; from thence through the exhaust port and out of the stack, causing a blow similar to broken cylinder packing or broken valve seat. It can also be determined, when running, by a blow occurring between exhausts; as, for instance, if but one of the by-pass valves was stuck-up or broken, you would have three normal exhausts at the stack and one blow. If both by-pass valves on one side were stuck-up or broken, however, there would be a continuous blow at the stack. The broken valve can be located by testing as above; and when the engine is placed in the position where the blow occurs, place the reverse lever in the opposite corner. If the blow stops, it will indicate that the defective valve is at that end of the cylinder that was in communication with the steam chest pressure through the ports, when the lever was in its first position; as, for instance, say that the test was being made for a defective by-pass valve at the right low pressure cylinder, and the locomotive was spotted with the main crank pin upon the upper quarter. Now, if the blow occurs with the reverse lever in the forward corner but not in the back corner, it is evident that the back by-pass valve on that side is either stuck or broken. After locating the defective valve, take off the valve cap, remove the valve, and if it was simply stuck, clean it off thoroughly; oil it with headlight oil, and replace it. If the valve is broken, and broken in such a manner that it will still make a seat if blocked down, block it in place, holding it with the valve chamber cap. If it is so broken, however, that it can not seat, either slip a blind gasket between the by-pass valve chamber and the port communicating to the steam port; or, with some types of by-pass valves, slip a blind gasket into the connecting steam pipe.

GRADES AND CURVES.

G. F. L., Sorel, Quebec, writes: Given the tractive force of an engine as 800 tons, the rate of grade one per cent., the degree of curve four per cent., length of grade 2,500 feet, and length of curve 600 feet, what tonnage should be deducted for above conditions, train running at a speed of 20 miles per hour? A.—When a train is hauled up a grade, the resistance is increased by lifting the train against gravity. One mile equals 5,280 feet, and if the grade be one foot per mile, the extra pull necessary to lift a ton of 2,000 pounds will be 2,000 ÷ 5,280 = .3788. Therefore, the total resistance due to grade in pounds per ton of 2,000 pounds, the rise in feet per mile must be multiplied by .3788. If the grade is expressed in feet per hundred a per cent., the resistance in pounds per ton will be 2000 ÷ 100 = 20 pounds for each per cent. of grade. The resistance owing to curves amounts to from .7 to 1.0 pound per ton per degree of curvature, the lower figure being used on large capacity cars, and the higher figure for small capacity cars, as in the latter case there are more wheels and axles per ton of weight than in the former. A four per cent. curve would therefore require an increased tractive effort equal to 3 or 4 pounds per ton. Assuming that 6 pounds of tractive effort per ton will move a train of cars on a level, straight road at 20 miles per hour, and this amount has been generally acknowledged to be nearly correct, the amount added on account of a grade of one foot per mile and a curve of four per cent. would require a tractive effort of 6 + .3788 + 4 = 10.3788. Therefore, as 10.3788 is to 6 so is 800 tons to 462.5 tons. If on the other hand the grade is expressed in feet per hundred and one per cent. of 5,280 feet being 52.80 per mile. 20 pounds will have to be added instead of .3788 or 6 + 20 + 4 = 30. Therefore, as 30 is to 6, so is 800 tons to 160 tons. The length of a grade or curve does not materially affect these calculations.

INJECTORS AND BACK PRESSURE.

J. F. Heyser, Macon, Ga., asks.—(1) Are there any injectors that operate automatically? That is will the injector start itself when the water falls in the boiler to a certain level? (2) Are there any valve motions in use where separate valves are used for the exhaust? I understand that there is considerable loss from back pressure as the exhaust steam has to pass through the same port that it entered the cylinder, and the port has to open before the steam has finished its work. A. No. Devices of this kind are in use in water heaters where the pressure is only a few pounds, but they could not be operative in high pressure boilers. (2) In compound locomotives, valves are in use that open to receive the steam that has passed through the high pressure cylinder, the steam so exhausted or reduced in pressure being then conducted to and through the low pressure cylinder before being finally exhausted to the open air. In simple engines where the valves are properly adjusted there is little or no loss from back pressure for the reason that by the time the piston has nearly reached the end of the stroke the volume of steam admitted to the cylinder has become reduced in pressure so that it is only a little above the pressure of the atmosphere. When the valve opens to the exhaust port the exhausted steam readily finds its way to the outer air, the only back pressure being the pressure of the atmosphere. Indicator cards show the amounts of pressure at the different points very clearly.

WATER BRAKE.

G. H. S., Northfield, Vt., writes: Would you please explain the proper way to handle the La Chatelier water brake in mountain service? I have used the brake, but perhaps not correctly. A.—Numerous attempts have been made to utilize the reversed engine as a brake for stopping the train, and even by this means to save some of the power lost in stopping. Chatelier, an eminent French engineer, experimented for many years on this mechanical problem. His method was to inject a jet of water into the exhaust pipe, which supplied low-tension steam to the cylinder, instead of hot gas or air coming through the smokebox. This was pumped back into the boiler on the return stroke. Thus the act of stopping a train was used to compress a quantity of steam, converting the work of stopping into heat, which was forced into the boiler and retained to aid in getting the train into motion and speed again. The Chatelier brake was not a marked success. In the absence of high-power brakes, it met with some applications in Europe. It has been used on some of the mountain roads in America under the name of the water brake, as an auxiliary to the automatic brake.

LEAKY ROTARY VALVE.

N. J. B., Lakeland, Mich., writes: What is the effect of a leaky rotary valve in the H6 brake valve? A.—The effect depends upon the amount of leakage past the valve seat, and the amount of leakage from the brake pipe, and in a measure, upon the condition of the distributing valve. If rotary valve leakage exceeds brake pipe leakage, the effect will be to increase the brake pipe pressure, and after an application of the automatic valve and return to lap, if the brake pipe pressure rises faster than it can flow past the equalizing valve packing ring into the pressure chamber, the equalizing valve will likely be forced to release position, but the brake will not release from this cause alone, as the release pipe is closed with the valve handle in lap position.

Should the equalizing valve be moved to release position about the time, or at

the instant, the application piston is in application position supplying brake cylinder leakage, a momentary sharp exhaust of brake cylinder pressure from the distributing valve may occur.

BROKEN AIR PIPE.

W. N., Princeton, Ind., writes: Is a broken reducing valve pipe of the E. T. brake sufficient cause for an engine failure, and what is the correct method of procedure in the event that the air pipe is broken off in passenger service? A.—We do not think so. If the reducing valve pipe breaks off while running along the road it is only necessary to reach over and slack off the adjusting screw of the reducing valve, and carry the handle of the independent brake valve in lap position. After an automatic application you can release the engine brake by moving the independent valve to application position. In case there was a very poor spring between the rotary valve and key of the independent valve, or if any reason the rotary valve is lifted off its seat by an automatic application, the broken pipe can be plugged toward the independent valve and the handle carried in running position, and if necessary to release with the independent valve, it can be moved to its release position.

This break would of course destroy the signal whistle and the application of the independent brake.

POSITION OF BRAKE VALVE HANDLE.

W. W. P., Newark, O., writes.—Is it good practice, or is there any advantage whatever in using a midway position at any point between running and release position of the H6 brake valve, in order to keep the pumps running when the S. F. type of governor is in use? A. The position of the brake valve handle you refer to is not a recommended practice, and we have suggested the use of such a position in the event of a supply valve piston of the feed valve sticking shut when out along the line of road, or under certain conditions of a broken feed valve pipe, so that it would be unnecessary to disconnect or plug the excess pressure operating pipe in order to keep the pumps in operation, but in train brake manipulation, release or running position should be used.

In coupling to a long train of uncharged cars, the engineer may wish to prevent the "racing" of the pumps against a low air pressure, and he can find a position midway between running and release position in which the excess pressure top of the governor will throttle the pumps to the desired speed, and we consider it a good practice, provided there is ample time in which to charge the train in this manner. When brake-pipe pressure is near the maximum running position should be used and the train should not be moved until the brake-pipe pressure can be maintained with the brake valve handle in running position.

BROKEN RETURN SPRING.

W. R., Jacksonville, Ill., writes: What is the easiest way to renew a broken return spring in the S6 independent brake valve? A.—Remove the handle and cover screws, the cover and casing screw, then the upper clutch, the spring casing and the broken spring. Put the lug of the lower clutch against the left hand side of the stop pin and one end of the new spring against the opposite side of the lug, from the pin. Then set the return spring casing on the spring in a manner that the upper end of the spring will fit in its abutment in the inside of the casing, then use some bent instrument that will catch both lugs on top of the casing and wind this return spring casing hard to the right until the slot in the side of the casing is in register with the casing screw opening in the valve body, then tighten the screw, slide the upper clutch on the rotary key and move the key in position to let the upper clutch engage the lug on the casing after which replacing the cover, screws, and handle, completes the operation.

USE OF TRIPLE VALVE.

W. G. L., New York, N. Y., asks:—Why would not the K-2 triple be as satisfactory in passenger equipment as the more complicated triples in use? A. The improved features of the K-2 triple valve are intended to attain the nearest possible approach to uniform brake operation on long freight trains and cannot be successfully used in place of passenger triples because their port openings are insufficient to control the larger volumes of compressed air in the specified length of time.

PRESSURE IN AIR PIPES.

W. R., Jacksonville, Ill., writes: What pipes of the E. T. equipment contain atmospheric pressure after an application of the independent brake? A.—The branch of the release pipe between the brake valves, and the pipe between the "dead engine" fixture and its 3/8-inch cut-out cock.

LIFT OF AIR VALVES.

W. R., Jacksonville, Ill., writes: What is the lift of air valves of the Cross Compound pump? A.—3-32 all around in the 8½ compressor, and in the 10½ compressor, the receiving and discharge valves have 5-32 of an inch and the intermediate valves 1/8.

Cementing Belts.

There has been considerable discussion in the mechanical papers lately concerning the best coating for belts that have to be cemented at the joints. The subject is important for belts that slip are as wasteful of power as a slippery locomotive. We have had experience with several coatings but none gave so much satisfaction as the following:

Take a good glue, add American isinglass equal parts by weight; place the material in a glue pot to add sufficient water to cover the whole. Let the mixture soak ten hours, then bring the whole to a boiling heat, and add pure tannin until the whole appears like the white of an egg. Apply warm. Buff the grain of the leather where it is to be cemented, rub the joint surfaces solidly together, let it dry for a few hours and the belt will be ready for use.

Tannin or tannic acid is an astringent substance used in converting hides into leather and produces a surface on a cemented belt similar to the original leather.

Good Habits.

Many young mechanics think that they are achieving popularity if they can gain the reputation of being fast in their work and conversation. That has ruined many a promising career. Rules for good work fail without good habits. Good habits are the physical basis of good work, just as love of work is its soul. Ruskin says that no immortal work has been done in the world since tobacco was discovered. Of course, this is not true, but the meaning behind it is true. No man can be at his best whose brain is inflamed by drink or whose nerves are shaken by narcotics. And we must be at our best. More and more other men are determined to be at their best. If every man is not at his best it is his own fault.

New Rule in Kansas.

Kansas is greatly given to the regulation of railways, although the State enjoys a magnificent system of transportation facilities which the people paid nothing to construct. The latest regulation pending is a bill providing that when two trains approach a crossing, both shall stop and neither shall go ahead until the other has passed by. In our opinion that involves a problem in train movement that will push engineers to their wits' end.

Increase in Railroad Earnings.

The total revenues of the railroads of the United States for 1912 amounted to $2,923,936,957, of which $2,033,474,191 was derived from freight traffic. Every mile of railroad, according to the report of the Interstate Commerce Commission, earned a net income above all expenses of $3,609 for the year, an increase of $163 over the net revenue per mile of line for 1911.

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Harry A. Kenney,
Gen'l. Mgr.

Sworn to and subscribed before me this thirty-first day of March, 1913.

Oliver R. Grant,

Notary Public No. 1398, New York County. Commission expires March 30, 1915.

Use of Intense Heat.

Until within a comparatively recent period all artificial heat was produced by some sort of combustion, the most common form being the burning of carbon by its combination with oxygen. Until within a comparatively recent period the best informed persons concerning the manifestations of natural phenomena, believed that heat was a subtle fluid without weight which emanated from fire and various other sources. The general introduction of machinery produced phenomena that set scientific investigators searching deeper into the cause of certain parts becoming hot without any connection with the processes of combustion. When the axle of a car became hot it was natural to investigate the real cause and this led to the discovery that heat, instead of being a material substance, was a mode of motion.

The names of the apostles of engineering science who took the lead in the investigation of heat phenomena ought to be familiar to all intelligent engineers. There were speculations concerning heat among the learned men of ancient Egypt, but their ideas exerted no influence upon modern engineering practice. The real revival of the researches that resulted in the invention of the steam engine began about the beginning of the eighteenth century, when Mariotte, a French physicist, discovered that the pressure of a gas varies inversely as its volume. That is known as the Mariotte law. About a century later Benjamin Thompson, an American engineer, discovered and proved the immateriality of heat and demonstrated the fact that heat and mechanical work are mutually convertible.

That discovery made by Thompson paved the way to the utilizing of water powers such as Niagara Falls for the conversion of mechanical power into heat, which has effected a revolution in many industrial processes.

Industrial processes are now carried on by the power provided by Niagara Falls that seem almost miraculous and would have been regarded as impossibilities only a few years ago. Among the modern miracles done at Niagara are the manufacture of carbide of calcium for acetylene gas, the grinding of carborundum from ordinary carbonaceous materials, the production of graphite which is reported to be better than the natural product, the extraction of refractory metals from their ores, the elimination of phosphorus from metals, and its admixture into articles of commerce are examples of the new industries made possible by utilizing the immense power of Niagara Falls.

The scientific engineering chemists who are carrying on that work, have also made many metallic alloys which could not be used a few years ago owing to the great expense of their production. Ten years ago sodium was a curiosity that cost sixty cents an ounce and is now produced by the use of electrical heat so easily that it is sold for twenty-five cents a pound. By the same power mercurial nitrates may be produced in bulk.

Thermit, another product of the electric arc so produces intense heat which is now used to a considerable extent in railway repair shops for the welding of frames and other parts of rolling stock. The inventor of this substance discovered that aluminum has a great affinity for oxygen. To make use of the affinity he mixed granulated aluminum with oxide of iron. A small quantity of magnesium filings was placed on top of the mixture and heat applied, when immediately a mass of molten iron was seen boiling at a temperature of 5,400 degrees Fahrenheit, a temperature seldom attained before that experiment was made.

A striking example of the wonderful work done by thermit is mentioned by William Allan Sutherland in an article contributed to *Chambers Journal.* In the Thames Iron Works and Shipbuilding Works a fractured frame 32 feet by 14 feet and about 10 tons in weight was successfully repaired by the thermit process and a lower post of suction 10¾ by 7¾ inches was joined to the main frame. The fracture was opened out about 1¼ inches so that the molten material might flow between and around the two ends to be welded. A mould of sand was placed round the fracture and the broken ends were made red hot in a special furnace. Then a crucible containing about four hundredweight of thermit mixed with a quantity of iron punchings and one per cent. of manganese was ignited. In exactly one minute the mixture was molten at a temperature of 4,000 to 5,000 degrees Fahrenheit and was allowed to flow into the mould to cool and set. The welding was successfully completed and the junction resisted all subsequent tests. The marvel to the onlookers was the extraordinary rapidity with which the enormous heat was generated and the mixture fused. It was estimated that to generate such a temperature by the electric arc nearly 100,000 horsepower would be required. The process is now in general use. When the Friedrich der Grosse broke her propeller shaft it was satisfactorily and promptly repaired by this means.

There appears to be no limit to the future possibilities of the application of intense heat to industrial processes and men of science are constantly experimenting with the object of obtaining still higher temperatures wherewith to work still greater marvels. Nevertheless, such is the cost of the process in its application to the making of the infinitesimal diamond crystals which are yielded by the furnace that the dealers in nature's diamonds need have no fears at present of the competition of their chemical rivals in this direction.

Inventors of the Locomotive.

It is curious to notice how persistent error is in connection with the development of the locomotive engine. If one mixing with a group of intelligent engi-

neers attending Brotherhood meetings asks the question who was the inventor of the locomotive, nineteen out of twenty will answer George Stephenson. Now so far from being the inventor of the locomotive, George Stephenson did not put a single improvement upon the engine.

The first locomotive to run on rails and capable of hauling cars was built by Richard Trevithick, a Welsh mining engineer, in 1803. He did not persist in that line of invention or improvement, and next, ten years later, William Hedley, another colliery engineer, superintended the construction of a locomotive engine, which was put into the service of hauling coal cars. That engine was not so satisfactory and a second one was built, and worked many years. It is now to be seen in the Patent Department of the South Kensington Museum, and is called The Puffing Billy. It is interesting to mention that Frank Hedley, vice-president and general manager of the Interborough Rapid Transit Co., of New York, is a grandnephew of the inventor of the "Puffing Billy." George Stephenson, who was also a colliery engineer, made sketches of Hedley's first engine, and built an imitation which never worked well.

The first high-speed locomotive was built by Robert Stephenson for the Liverpool & Manchester. It was called the "Rocket." Its design and construction are generally credited to the older Stephenson, when they really belonged to his son Robert.

The American locomotive is an evolution of native mechanics and represents the steady progress of evolution during seventy years. When the primitive locomotives of the decade extending from 1830 to 1840 were built their designers were experimenting to find the fittest form for the work to be done. When John B. Jervis in 1832 placed a four-wheel guiding truck in the front of an engine and a pair of driving wheels behind he gave to the railway world the type that in a direct line produced the variety of types that constitute the railway motive power of today.

The first locomotive to do practical work on a railroad in the United States was Peter Cooper's Tom Thumb, which demonstrated that the crooked track of the Baltimore & Ohio could be operated by locomotives. That engine developed about one and a half horse power, and the chief objection raised was that it was not powerful enough. That objection has been repeated year after year ever since by the officials responsible for moving traffic at low cost, and the men in charge of the motive power have gone on increasing the weight and power of the locomotive until we have passed the two-hundred ton mark for engine alone with drawbar pull of about 75,000 pounds.

There have been periods of railroad history when the increasing weight and power of the locomotive advanced very slowly; at other times the demand for more powerful engines has been strenuous. Never was this demand so urgent as it was during the last five years of the 19th century, and the stimulus brought forth the speedy and powerful engines that seem to have reached the full capacity for a track having a gauge of 4 ft. 8½ ins.

The principal improvement effected on the locomotive since it assumed the form given by Jervis has mostly been done by increasing weight and dimensions, adding driving wheels and putting on conveniences for operating. Great efforts were made to give the pioneer locomotives an ornate appearance, but they never had the real finish possessed by the vital parts of the 20th century sombre decapod. The line of progress has been in the improvement of the quality and finish of material. Among the beneficial changes effected were: The putting of iron and steel into frames and driving wheels that formerly were partly of wood; counterbalancing the driving wheels; making the fire box and boiler suitable for burning any kind of fuel that could be purchased at the lowest price; using equalizer levers between the driving wheels; placing the cylinders horizontally instead of vertically or inclined; using steel tires instead of iron; using steel for fire boxes and boilers instead of copper or iron; using iron or steel for tubes instead of brass or copper; introducing reliable boiler-feeding appliances; and equipping the engines with reliable cylinder lubricating apparatus.

All these improvements helped to increase the efficiency and durability of the engine and therefore enabled it to reduce the cost of hauling passengers and freight. The demands for increased efficiency and economy which have been rampant in the last five years of the 19th century have brought forth many compound locomotives, increase of size, higher steam pressure, piston valves, longer boiler tubes, larger proportion of grate area to heating surfaces. The utility of some of the "improvements" may be in doubt but the changes are in evidence.

Managing Men.

We have frequently commented in these columns on the advantages that accrue to employees by having superintendents, foremen and others who possess the valuable faculty of managing men. We notice that the Secretary of the Navy Department made that the subject of an address to the graduates of the Naval Academy at Annapolis. He informed the young men that their success in life depended less upon their technical knowledge than upon their power of managing men. The power of managing men is the primary element in successful administration.

Successful administration is, in turn, a primary element in the progress of the world.

The science and the art of managing men depend upon, first: appreciation of the thought and feeling of the men whom it is desired to manage. This element embodies the quality of putting one's self in the other man's place. Understanding of the condition of the one whom it is desired to influence is to be secured. When this altruistic point of view is gained the administrator who seeks to manage men is to understand his own position and condition. He is to know the strong points and the weak of his own case. Having this understanding he should be able so to adjust these points to each other as to present them in a persuasive way. He is so to present the truth that it shall result in persuasion.

Besides the power of appreciation of his own and of his opponent's position, the man seeking to manage men is to exercise two special qualities: pleasantness and patience. The man who is to persuade other men is not to get mad. He is to remind himself of the old remark of the relative catching quality of molasses and vinegar. Morley, in his life of Gladstone, writes of a member of a Cabinet who had the virtue of being pleasant. This virtue is to belong to the modern executive. But, in addition to pleasantness, he is to have the power of waiting. He should not seek to secure results in undue haste. He is to be willing to adopt manifold means for securing his end, and he must be willing to take proper time for the use of these means. Gentle and constant pressure will bring forth, in his patience, the result desired, when the lightning of a sudden impulse might destroy his cause.

Electric Locomotives.

In our electrical department for this month there is a description of a very powerful electric locomotive, ten of which have recently been ordered by the New York Central and Hudson River R. R.

The operation of these locomotives will be watched with a great deal of interest, not necessarily from an electrical point of view, as the state of the electrical art has reached the point where motors and control apparatus can be built to operate almost 100 per cent. perfect, but from the mechanical side. One would say, offhand, that since electric motors have rotary motion, they would be ideal for motive power since same could be mounted directly on the axles without any connecting apparatus, as side rods or gears. These new locomotives have the motors mounted in this way. This method, however, has a de-

cided disadvantage, for the centre of gravity is necessarily low.

Due to the inherent design of the steam locomotive the centre of gravity is high and exhaustive experiments have shown that the high centre of gravity is an aid to track maintenance, and that the riding qualities of the high speed passenger steam locomotive, as regards its damaging effect on the track can hardly be improved upon.

Again this new electric locomotive has power applied to its leading or guiding truck wheels, which also carry as much weight per axle as the fixed wheels. This arrangement is a departure from standard railroad practice. Will this departure from standard practice, for the sake of utilizing all the locomotive weight for adhesion, prove a success at high speeds?

The First Signalman.

The short time that has elapsed since railways were first put into operation is illustrated by the fact that the first man employed in operating fixed signals has just passed away. He was known as Sandy Hamilton, and he entered the employ of the Edinburgh & Glasgow Railway in 1842. He retired from the service a year ago.

Sandy's selection as the first railway signalman in the world was due to the ingenuity, resource and general handiness which were among his earliest traits.

The earliest railway signal was the clock tower, so long a feature of Cowlairs Station prior to its demolition in August, last year. Its purpose was to warn all concerned when a train was on the line in a tunnel from Queen Street Station, and it was worked by a wire attached to a lever in the stationary engine house. This was under the control of the engineman in charge of the haulage rope, and the plan worked so successfully that it occurred to the N. B. railway officials that a general system of signaling could be worked in the same way.

So the experiment was tried, and Sandy being a handy chap, was entrusted with the working of the primitive cabin. The levers were placed in front of an open platform, about 12 feet high, under the west canopy of the tower, whence trains approaching the station in either direction could easily be seen, as there was then no such things as raised railway platforms, waiting rooms, etc., for the convenience of passengers. Sandy's signals, too, were a primitive affair compared with the elaborate semaphores of today, but it was their forerunner, they being introduced about 1859, when the junction for the Helensburgh railway was made at Cowlairs.

It was about the same time that points or rail switches began to be worked from the cabin, and the services of ground pointsmen to a great extent discontinued. After serving a time in the working and teaching of others, Sandy was promoted to the position of goods guard, which in those days was considered much more important than that of signalman.

Freaks of Nature.

There are about seventy elementary substances in nature which, by combining with each other, form the immense variety composing the earth and all therein. There are many curiosities in the products of the same elements combined in different arrangements of the atoms.

All railway men are familiar with hearing coal called black diamonds, which is a crude truth, for the diamond is only charcoal crystallized; but there are a great many other things in nature that, though possessing widely different properties, are composed of exactly equal quantities of the same elements.

The white of an egg and rattlesnake poison are formed of identically the same amounts of the same elements.

The oil of roses and common coal gas are each formed alike, both being composed of four atoms of hydrogen and four atoms of carbon.

Sugar and gum arabic are likewise brothers of the same weight and texture.

All the hydrocarbons, known to science as a combination of sixteen atoms of hydrogen and ten atoms of carbon, are alike in their composition. To enumerate some: Oil of orange, lemon, cloves, ginger, and black pepper.

The suggested explanation of these peculiarities is that the atoms are placed differently towards one another in the molecules of the different substances.

Other things just as peculiar are evident when certain substances are united chemically. Thus hydrogen gas, which is odorless, and nitrogen gas, which is also odorless, when united go to make ammonia, which has a very strong odor. Copper, which has no odor, and zinc, which has also none, when melted and mixed to give us brass, produce a substance with a characteristic one.

Fast Trains.

We are hearing very little discussion about high train speed these days, the occurrence of numerous fatal train accidents due to reckless speed having moved many persons influential in ruling train movements to prefer safety to spectacular high speed.

Nevertheless, although caution has become more powerful among American railroad managers than desire to excel rival lines, the subject of railway speeds possesses a keen interest for a great number of persons, especially in Europe where trains are operated under conditions that make high speed safer than it is in the United States. Tales of high speed made by certain trains are about as reliable as the stories of sportsmen who catch big fish, and some of us have learned to put as little reliance on particulars of a tremendously fast run as we would put upon a fish story unless they are corroborated by a train dispatcher's sheet.

Ever since railways emerged from infancy a rate of speed of "a mile a minute" has been held up as an ideal. Doubtless, the alliteration of the phrase is the secret of its popularity among those who do not realize that despite 70 years of progress it still represents the limit for a start to stop run—in which varying conditions of grade and alignment, together with traffic exigencies, have invariably to be reckoned with—performed in normal circumstances.

Our most famous long journey express trains come considerably short of the mile a minute speed. The total number of scheduled runs at that rate of speed is very small and spreads over three countries. Great Britain takes the lead as follows:

Darlington to York, 44¼ miles, in 43 minutes; Forfar to Perth, 32½ miles, in 32 minutes; Woodford to Leicester, 34 miles, in 34 minutes—total mileage, 110¾. The French array is better and belongs wholly to one company, the Northern—Paris to Busigny, 112½ miles; Paris to St. Quentin, 95¾ miles (performed three times); Paris to Longueau, 78¾ miles; Longueau to Arras, 41¼ miles, each of which is accomplished in as many minutes, less fractions. The French mileage totals 519¾. The United States is the third country, and here this rate of speed appears to be confined to two rival routes between Camden and Atlantic City. By the Philadelphia & Reading Company's line the distance of 55½ miles is covered in 50 minutes, speed 66.6; and by the Pennsylvania route, which is 59 miles in length, there is a train in 52 minutes—speed 68 miles per hour. Both companies run, however, many other Atlantic city "flyers," booked at "a mile a minute."

There are several runs on British railways which fall only a decimal point or so short of this standard, and which are more meritorious performances than those enumerated above, viz: London and Bristol, 118½ miles, in 120 minutes; Leamington to Ealing, 100½ miles, in 101 minutes; London and Bristol, via. Badminton, 117½ miles, in 120 minutes; York to Newcastle, 80½ miles, in 82 minutes.

Fuel Saving from Different Sources.

Some remarks made by our friend, Mr. F. P. Roesch, in a discussion at the Traveling Engineers' convention last

summer, seem to deserve reproduction in our pages. Mr. Roesch said:

"We all recognize, speaking first of high degree superheaters, that all who have had anything to do with the high degree superheater in its present form have become rather enthusiastic in its support. In fact, we have in many instances allowed our enthusiasm to so far get the better of our judgment that we make statements that probably appear to be a little wild. I might refer now in particular to one statement that was made this morning, and while I know from personal experience what can be gained through the use of the high degree superheater as applied to road locomotives, yet I must confess that I am somewhat skeptical as to the results which were said to have been obtained on switching service. A member made the remark that he obtained 50 per cent. fuel economy on switching engines in short switching service. When we take into consideration the fact that the average amount of fuel burned on a switching engine is very low indeed, and then say that we can cut that in two, we are making what I believe a rash assertion Gentlemen, as you probably all know, I am from Missouri, and like to be shown these things. In the first place, we do not want anything to go from this convention that we cannot verify. We want our reports to be just as accurate as any report that emanates from the Master Mechanics' Association or from the American Society of Civil Engineers, and consequently any statement that is made should be backed up by facts and figures; and while I do not say that the gentleman was not right—he may have accomplished this—yet to say that it is all due to the application of the superheater sounds rather questionable. We all know that in making tests of any particular device with the idea of proving the efficiency of that device, we take the utmost care in saving fuel or anything else, and possibly the results accomplished are due as much to the care taken in the saving of fuel as they are to the application of the superheater itself. If the statement had been made that it effected a decrease of 25 per cent. in fuel, I probably would have accepted it without question, and therefore I would suggest that if the superheater people have any accurate data bearing on this subject they be permitted to render a supplementary report covering the same, to be published in our proceedings in connection with this paper. We all know that if we can get that degree of economy in a switching engine through the application of a superheater, we would be foolish to stand back for one minute; we ought to equip all of our engines. I would like to be able to go back and recommend to my superintendent of motive power that we can do this; but without good and sufficient evidence I cannot afford to put myself on record, and I do not believe that this association can afford to put themselves on record to the extent that you can save 50 per cent. in fuel.

"Another thing that was touched upon but not completed is the economy effected through the use of the superheater where oil is used as fuel. All said that an economy was effected, but the percentage of economy was not touched upon. It is something that can be very easily obtained where oil is used as fuel.

"One of the speakers called me to task, stating that I had made the remark either on the floor or in the paper, that the labors of the fireman had been increased, due to the application of the superheater. Gentlemen, I think he was in error. He either misunderstood me or he misread the paper. The paper itself and all the discussion on the floor today prove the contrary to be the case; because if applying the superheater to the same locomotive that had originally been a saturated steam locomotive effects a reduction of 25 to 30 per cent. in fuel, unquestionably the fireman's labors have been reduced in a like proportion.

"The question of maintenance cost, while it has nothing to do with fuel economy on a locomotive equipped with a superheater, yet must be taken into consideration due to the fact that if the application of a superheater will increase the cost of maintenance beyond the amount that is saved in fuel, then we cannot afford to put on this extra appliance. Our experience so far has covered a period of two years, and during that time we have found no appreciable increase in the maintenance cost of the locomotives, with the exception of where on some of our locomotives we increased the tractive effort beyond the tractive effort that obtained when we were using saturated steam. The result is a great piston thrust, and of course an additional wear on the bearings, but I believe that I am safe in saying that unless the original factor of safety on the locomotive was remarkably low, the increased tractive effort due to the application of superheat will not materially increase the cost of maintenance. The only additional cost that we have found up to date was increased wear on the main rod brasses. We have not had any failures whatever due to the breaking of pins, rod, axles, etc., although in some instances we increased the tractive effort almost 16 per cent.—from 43,000 to 50,000 pounds tractive power. I might touch, in passing, on one remarkable thing that we learned in connection with this and that is that if with a superheater locomotive we could use a lower factor of adhesion than we were able to use with a saturated steam locomotive and obtain equally satisfactory results as far as slipping, etc., was concerned."

The Vindication of Arbitration.

The pleasant settlement of the dispute between the firemen and the railroads by the arbitration board appointed to consider the subject, and the fact that the decision itself, favorable as it is to the employees, was made unanimously by the board serve to enhance the reputation of such tribunals as courts of last resort in labor disputes and also to demonstrate the absolute folly of strikes in the twentieth century.

The substantial increase in wages which the firemen have received makes clear their claim that they were entitled to it.

The public has had a real benefit by the avoidance of severe and unnecessary hardship incident to a great railway strike, and both the employees and the great railroad corporations involved are to be congratulated on escaping the losses incident to a paralysis of the transportation lines, with the consequent stoppage of wages and dividends.

The value of the result can hardly be exaggerated. The attitude of the employees and employers in the controversy has been admirable; the discussions were carried on in a kindly spirit. We never saw an instance where free speech was more welcomed and encouraged, and the result has been that a great disaster has been averted, and in a large sense humanity are brought nearer together.

Physical Value of Railways.

What is known as the Physical Valuation Act of the Railways of the United States, approved by Congress on March 1, became operative on May 1. The leading railway officials are preparing to adopt a decided policy in regard to the act. A permanent committee of Eastern railway officials has been organized, with Samuel Rea, president of the Pennsylvania Railroad, as chairman. Several conferences have been held.

The politicians who promoted the Physical Valuation Act expected to show that the value of the railway property in the United States is highly fictitious, but we understand that shocking surprises are in store for the people who habitually depreciate the transportation properties. Some preliminary investigations made by experts indicate that the real value of railroad property is away beyond the most sanguine calculations.

The talk in Chicago is that the officials interesting themselves in the Physical Valuation of Railways are working for the appointment of Wilson E. Symons as one of the commissioners.

Air Brake Department

Frozen Air Pump Cylinders.

In the February issue, one of our correspondents, writing on the subject of frozen and bursted air pump steam cylinders, suggests a new type of cylinder chiefly intended to overcome or reduce the number of cases of damaged cylinders due to freezing. We have waited to hear of some comments upon this subject from other readers, and while the time of freezing, for the present season, has passed, we may suggest a method of air pump steam line installation, that, if followed, will prevent any annoyance and additional expense from frozen cylinders during the coming winter.

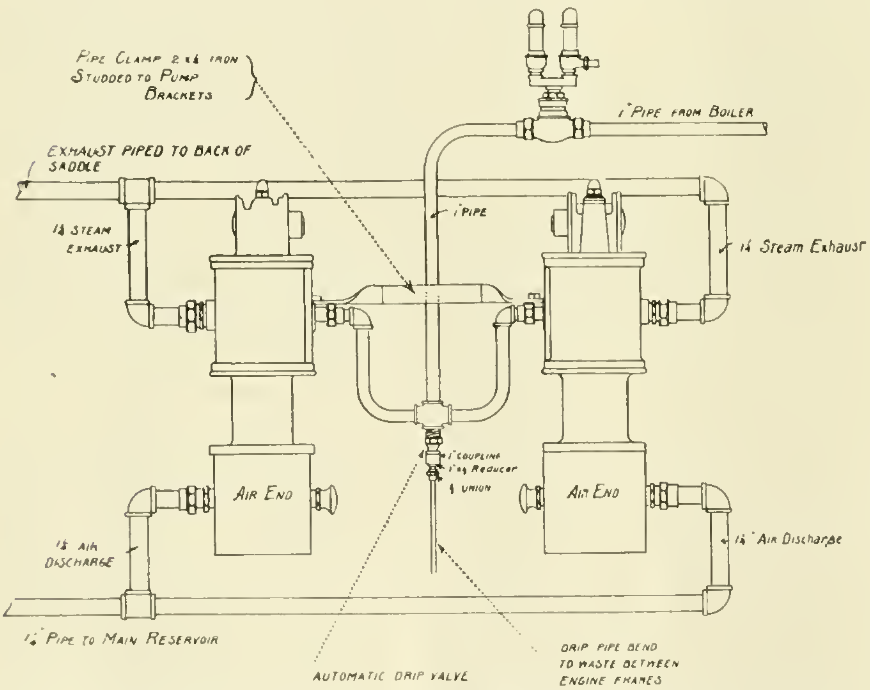


Diagram of two-pump piping adopted by the Maine Central R. R. to collect condensation and prevent same passing to pumps. In use on forty engines and no case of freezing in entire term of service of four years.

Without commenting upon our correspondent's idea, it is obvious that the freezing and bursting of steam cylinders of the present form can be prevented by opening the cylinder drain cocks, which were supplied for the purpose of draining all the condensation from the pump and pipes, and if they are applied and used water cannot accumulate in the cylinders and freeze.

The writer has had considerable experience with frozen air pumps, and knows that standard instructions covering the use of drain cocks are not always observed. This is nearly always inexcusable, but in some cases terminal facilities are inadequate, engines may be found hundreds of yards from the engine houses with their fires drawn and no one present to give them any attention; in fact, the amount of help employed may be insufficient to properly care for the number of engines that can be placed in the engine house, and as a result, cold weather brings on a great deal of freezing up, which means a loss of the repairmen's time and a heavy increase in the cost of air brake maintenance.

If, under any condition or a combination of circumstances, a strict observance of the use of the drain cocks may appear to be impracticable, we would call our readers' attention to a method of piping and an automatic drip valve, used by the Maine Central Railroad, which prevents the accumulation of condensation in the steam cylinders. In this installation of steam pipe, a portion of the pipe, is lower than its entrance to the cylinder and at the lowest point in the piping the drip valve is relied upon to accomplish its purpose. This drip valve may be of any ordinary valve arrangement held open by spring pressure, and opened by the closing of the pump throttle and closed by the admission of live steam to the pipe.

This arrangement was first brought to our notice during the winter of 1910-11, and there was not a single case of freezing on any of the locomotives so equipped, during the four years the drip valve was used in the steam pipes.

It naturally follows that if this valve and piping arrangement will automatically keep the condensation from entering the cylinders during cold weather, it will also be of advantage and a very economical device to prevent the accumulation of water from being forced through the steam valve mechanism of the pump during any kind of weather.

Absurd Practices.

Quite a large number of Firemen who pass the examination for promotion to the position of locomotive Engineer never make good. The time they remain in the service as engineers ranges from three months to about two years. There are, of course, various reasons for their failures, but in connection with the maintenance of the air brake, we have had an opportunity to pay particular attention to the work reports left on file, and to observe the habits formed by these men in reporting the work to be done.

How they conceived or became imbued with the ideas their practice suggested, has been a constantly increasing mystery, and to the best of our ability, we have attempted to formulate a set of rules which these men unconsciously or ignorantly followed, or, in other words, they would have been obeying orders if the company's rules were similar to the following:

Never take any advice from an air brake instructor; he derives his knowledge from books.

Pay no attention to the results of an air brake demonstration; the instructor has arranged the piping to accomplish his own ends.

Never read anything in a technical publication; the people who write that stuff are just out of school and have no practical experience.

Never read air brake instruction books; they were prepared by the brake manufacturers who sell the equipments.

Never leave a terminal without a hammer and chisel; an union air pipe connection might start to leaking and you would have nothing to caulk it with.

Don't worry if the caulking increases the leakage; it leaves you on the safe side if the adjusting nut of the governor is screwed down too far. A number of good sized leaks may prevent a main reservoir explosion.

Be sure the chisel is sharp; it will take some time to ruin the connection if the chisel is dull.

Have a bucketful of oily waste; you may want to build a fire on the distributing valve when it re-applies from leakage and an overcharged brake pipe.

If the fire warps and loosens the bushings, a new valve costs but 70 dollars, and the company holds a contract which entitles them to 25 per cent. off.

If the distributing valve fails to release during warm weather, tie the independent brake valve in release position.

Always carry a few wooden plugs and a knife; you can then plug the oil holes in the brake valves and distributing valve after you have stripped the threads.

When about ready to leave the water plug, move the automatic brake valve handle to release position and note results; then send the fireman after some one to again reduce the pressures to the proper figures.

When coupling to an empty brake pipe, leave the valve handle in running position; a little rest will do the pumps no harm, and by the time you get the engine house on the phone they will have started of their own accord.

While the train is being charged, wind up a few turns on the feed valve. With the hammer and chisel you can remove the hand-wheel stops.

When the pumps then stop with about 120 pounds pressure all around, use the hammer and chisel on the pump governor.

Remove the check nuts but never trouble yourself to replace them, as the shop men can always get some from another engine; their cost is trifling as compared with your peace of mind.

When entirely through winding on the governors, tap the steam valve cylinder with the hammer; whether the steam valve will thereafter stay open depends upon where the governor piston was when you hit it.

Whenever the train stops use up your time in adjusting the safety valve of the distributing valve; it keeps the threads from becoming corroded.

As the reducing valve is set at 45 pounds and the reservoirs equalize at 50 pounds, you can readily see how vitally important it is that the safety valve, which is set at 68 pounds, should be adjusted every few hours in freight service.

Handling the brake valve is a very simple operation; you have two positions in which to put them on and one in which to get them all off.

It is a good practice to move the brake valve handle to release position every few minutes while running along the road; it helps the feed valve to maintain brake pipe leakage.

When within half a mile of a stopping point, hold the handle on lap position until you are ready to start the application; it gives the pressures time in which to adjust themselves.

It is of advantage to be somewhat ambidextrous on the valves in the cab; with a little practice you can learn to simultaneously move the brake valve to release and open the engine throttle, which may be termed synchronizing cab operations.

A skilful method of applying brakes is when the rear portion of the train is ascending a grade while the head portion is descending; you can get the benefit of the grade in helping to hold the rear portion.

This is also an opportune time to release brakes, as the action of the grade will prevent a run in from the rear.

Another time when an opportunity to release can be taken advantage of is when the rear end happens to be back in a reverse curve, the curvature of the track will then assist to hold the rear end.

Some men make it a practice to move the handle to release position a second or two before making an application; this gives you more braking power and a prompt response of brakes, especially if the high-speed equipment is in use.

If the brake ever reapplies, release with the independent valve and upon arrival at the shop report that the straight air leaks on and have the independent brake valve cleaned without fail.

In any case of broken air pipe, governor or feed valve trouble, bring the engine in light; the company does not care whether you are resourceful in actual practice if you can put it up to some one else.

There isn't much to learn about the air brake after you get the regular results of defects, such as the leaky rotary releases the brake, brake pipe leakage applies it and a defective feed valve overcharges the brakes.

When the gage hands register about 110 pounds all around with the handle in running position, report the gages tested.

Never bring an engine on the fire track with the check nuts on the governors, reducing valves or safety valves; some one might get on the engine, note them in their places and think that you do not know how to adjust the pressures.

Never attempt to explain any unusual action of the brake; report the entire equipment as working "bad."

If you do report any peculiar action or "bad" action in detail, be sure to call attention to the graduating valve in the distributing valve.

Always refer to the reducing valve as an independent brake valve pressure controller; it tends to fill up the report and impress the roundhouse foreman.

Be careful about mixing the independent with the straight air; you could not make a shop man believe that straight air will flow through a crooked pipe.

Regardless as to what is wrong with the air pump, always report that the pump is "no good."

Should you consider it necesssary to specify what work should be done, report the discharge valves cleaned out. Even if dirt cannot collect on them it makes you feel that if more attention was paid to the work reports, the motive power would be in better condition.

When the pump groans pour some engine oil in the air strainer; the oil cup on the center piece is placed there to add to the pump's appearance.

In all cases of doubt, report the feed valve cleaned.

If the distributing valve has an unusually long exhaust when releasing the brake, report it cleaned. The brake cylinder piston travel will likely be noted and adjusted after you have run into something.

Always report a leaky air pipe to be brazed; it will at once convince the shop foreman that it would be useless to try to deceive you on pipe work.

In case of any signal whistle disorder, report the retaining ring in the reducing valve examined. The shop man may have some difficulty in finding it, but that is what he is getting paid for.

If the brake cylinder gage hand falls after an application of the brake, report the brake cylinder packing leathers renewed.

Should all four of the gage hands start to move upon an application of the automatic brake, report a casting flaw or a sand hole in the efficiency chamber. The shop men carry special plugs for such emergencies.

Always impress upon the shop man the fact that he knows nothing whatever about road conditions, and it is not likely that he will volunteer any information.

Accept everything coming from a brother engineer as authority. He has had the practical experience.

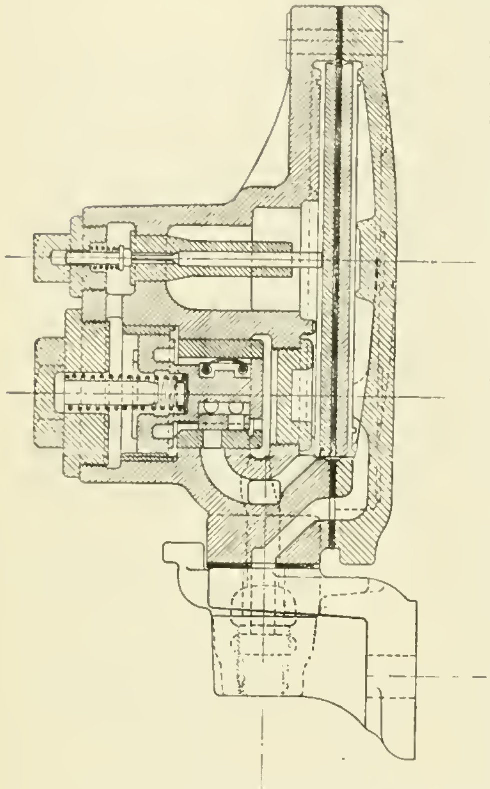
Following an imaginary formulation of rules similar to the above is partially responsible for the failure of some men to hold a place as a locomotive engineer, and a perusal of the above may be of interest to a large number of men who apparently have made good.

Sauvage Air Brake Attachments.

The October, 1912, issue contained an illustration and brief description of the Sauvage brake cylinder sustaining valve, and at that time referred to the locomotive train line sustaining valve invented by Mr. W. H. Sauvage, the well-known inventor of a large number of air brake devices. At the present time the latter valve has been perfected, and the accompanying illustrations show the pipe con-

nections of the locomotive sustaining valve, a general view of the operating parts.

A future issue will contain a view of



SAUVAGE AUTOMATIC LOCOMOTIVE TRAIN LINE SUSTAINING VALVE.

an improved brake cylinder sustaining valve, which, by the movement of the retaining valve handle will maintain brake cylinder pressure in release as well as application and lap positions of the triple valve. There is also a safety device that is for the purpose of safeguarding the balance of the system in case anything should happen to the locomotive sustaining valve, or even with the brake valve cut out, the brakes can be applied when this safety feature is in use.

At the present time it is only desired to deal with the locomotive sustaining valve. It has three pipe connections, to the brake pipe, the main reservoir and to the equalizing reservoir. It is similar in operation to the slide valve feed valve, the only difference being that its adjustment is regulated by the pressure in the brake valve equalizing reservoir instead of spring pressure. The supply portion is identical in appearance and construction to the supply portion of the B6 feed valve. The upper portion or the regulating valve stem rests against a large diaphragm, which has brake pipe pressure on the regulating valve side of it, and equalizing reservoir pressure on the other. Main reservoir pressure surrounds the supply portion and flows as far as the regulating valve seat, and the piston is operated like the feed valve, by the regulating valve being seated and unseated.

When the equalizing reservoir pressure is lowered by a brake valve reduction, the diaphragm tendency is to move away from the regulating valve stem, and no action of the sustaining valve is obtained, but if the equalizing reservoir pressure becomes greater than brake pipe pressure, as in the case of brake pipe leakage, the diaphragms will be forced to unseat the regulating valve which causes the supply portion to open and maintain brake pipe pressure in exactly the same manner as the feed valve maintains it in running position of the brake valve.

The locomotive sustaining valve has been in repeated rack tests in the Westinghouse Air Brake Company's shops. The valve action was perfect in every test on various lengths of trains, and no amount of tampering with the equipment ever caused the valve to fail. With leakage of from 5 to 25 lbs. per minute, the sustaining valve constantly maintained the brake pipe pressure, although the brake valve handle was allowed to remain on lap position from 15 to 30 minutes at a time.

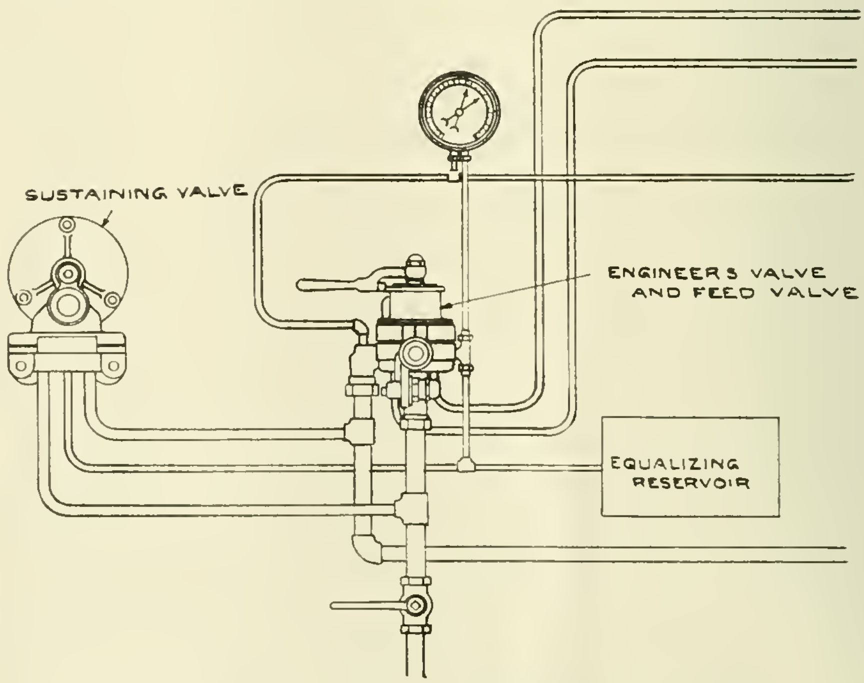
In instruction car work we frequently assume that a specified amount of brake pipe reduction should be made for the initial brake pipe reduction in stopping a train of cars, and that this reduction should not be exceeded or continued until the train is almost at rest, or given a certain length and makeup of train, speed of train, track and other general conditions being known or assumed, it may be pointed out that under the circumstances a 7 or 8 lb. reduction should not be exceeded, and be made far enough away from the desired point of stop for this reduction to complete the stop, and if the reduction should be 12 or 15 lbs. the effect of unequal braking power on the assumed train would no doubt break the train in one or two places.

In fact, air brake men have, during demonstrations, made up trains and handled them in a manner that a 15 lb brake pipe reduction wrecked the train, and such results were repeatedly obtained. Then if a fixed amount of initial reduction is necessary to successful train handling and brake pipe leakage continues the reduction beyond the figure, the engineer cannot be held responsible for making the stop, but obviously this sustaining valve makes possible a fixed amount of reduction.

The primary object of the valve is not to encourage the leakage in the pipes and offset the effects, but to maintain brake pipe pressure while the car valves are maintaining brake cylinder pressure against leakage.

In service this equipment has been entirely satisfactory, both for long trains and in heavy grade work, in one test of a train on a 2 per cent. grade 16 miles in length, 32 applications of the brake were required during the descent when the standard brake was used, and with the sustaining valves cut in but four applications of the brake were necessary to bring the train down this grade.

As stated, a future issue will contain a complete piping diagram of the entire equipment, with such descriptive matter as may be necessary to a complete understanding of the device.



PIPE CONNECTIONS OF THE SAUVAGE TRAIN LINE SUSTAINING VALVE.

Rotary Branch Pipe Strainer.

The small line drawing shows an interior view of the rotary branch pipe air strainer manufactured by the New York

TABLE SHOWING

(1) Amount of air lost per minute with different rates of leakage from combined volume of brake pipe and auxiliary reservoirs.

(2) Time required with different compressors to restore brake pipe and auxiliary reservoir pressure, considering total leakage only.

(3) Per cent. of air furnished by different compressors that is available for raising brake pipe and auxiliary reservoir pressure (Compressor capacity less leakage rate divided by compressor capacity) for 50 to 100 car trains with leakage of from 3 to 10 lbs. per minute from initial brake pipe pressure of 70 lbs.

Make of Air Comp.	Leakage from System in Lbs. per Minute.	50 CAR TRAIN. Vol. Free Air in System at 70 lbs. Pres.=450 cu. ft.			60 CAR TRAIN. Vol. Free Air in System at 70 lbs. Pres.=540 cu. ft.			70 CAR TRAIN. Vol. Free Air in System at 70 lbs. Pres.=630 cu. ft.			80 CAR TRAIN. Vol. Free Air in System at 70 lbs. Pres.=720 cu. ft.			90 CAR TRAIN. Vol. Free Air in System at 70 lbs. Pres.=810 cu. ft.			100 CAR TRAIN. Vol. Free Air in System at 70 lbs. Pres.=900 cu. ft.		
		Leakage in Cu. Ft. Free Air per Minute.	Minutes to Pump Back Air Lost by Leakage.	Percentage of Air from Comp. Available for Re-charging.	Leakage in Cu. Ft. Free Air per Minute.	Minutes to Pump Back Air Lost by Leakage.	Percentage of Air from Comp. Available for Re-charging.	Leakage in Cu. Ft. Free Air per Minute.	Minutes to Pump Back Air Lost by Leakage.	Percentage of Air from Comp. Available for Re-charging.	Leakage in Cu. Ft. Free Air per Minute.	Minutes to Pump Back Air Lost by Leakage.	Percentage of Air from Comp. Available for Re-charging.	Leakage in Cu. Ft. Free Air per Minute.	Minutes to Pump Back Air Lost by Leakage.	Percentage of Air from Comp. Available for Re-charging.	Leakage in Cu. Ft. Free Air per Minute.	Minutes to Pump Back Air Lost by Leakage.	Percentage of Air from Comp. Available for Re-charging.
W. A. B. 9½	3	15.9	.56	63.9	19.1	.76	56.6	22.3	1.03	49.3	25.5	1.38	42.0	28.7	1.87	34.8	31.9	2.64	27.5
	4	21.3	.94	51.6	25.6	1.39	41.8	29.8	2.10	32.3	34.0	3.40	22.7	38.2	6.58	13.2	42.5	28.3	3.4
	5	26.6	1.53	39.6	32.0	2.66	27.3	37.2	5.47	15.4	42.6	30.40	3.2	47.8	Beyond Comp. Cap.		53.1	Beyond Comp. Cap.	
	6	31.9	2.64	27.5	38.2	6.58	13.2	44.6	Beyond Comp. Cap.		51.1	Beyond Comp. Cap.		57.3	Beyond Comp. Cap.		63.8	Beyond Comp. Cap.	
	7	37.2	5.47	15.4	44.6	Beyond Comp. Cap.		52.1	Beyond Comp. Cap.		59.5	Beyond Comp. Cap.		67.0	Beyond Comp. Cap.		74.3	Beyond Comp. Cap.	
W. A. B. 11.	3	15.9	.31	76.0	19.1	.40	71.4	22.3	.50	66.5	25.5	.62	61.6	28.7	.78	55.7	31.9	.92	52.0
	4	21.3	.47	68.0	25.6	.62	61.5	29.8	.81	55.2	34.0	1.04	49.0	38.2	1.35	42.6	42.5	1.77	36.1
	5	26.6	.66	60.0	32.0	.93	51.9	37.2	1.27	44.1	42.6	1.78	36.0	47.8	2.56	28.1	53.1	3.96	20.1
	6	31.9	.92	52.0	38.2	1.35	42.6	44.6	2.04	33.0	51.1	3.32	23.2	57.3	6.23	13.8	63.8	23.6	4.0
	7	37.2	1.27	44.0	44.6	2.04	32.9	52.1	3.62	21.6	59.5	8.50	10.5	67.0	Beyond Comp. Cap.		74.3	Beyond Comp. Cap.	
W. A. B. 8½ C. C.	3	15.9	.13	87.8	19.1	.17	85.4	22.3	.20	83.0	25.5	.24	80.6	28.7	.28	78.4	31.9	.32	75.6
	4	21.3	.19	83.5	25.6	.24	80.5	29.8	.29	77.4	34.0	.35	74.0	38.2	.41	70.8	42.5	.48	67.6
	5	26.6	.25	79.6	32.0	.32	75.5	37.2	.39	71.6	42.6	.48	67.5	47.8	.57	63.4	53.1	.68	59.5
	6	31.9	.32	75.6	38.2	.41	70.8	44.6	.51	65.9	51.1	.64	61.0	57.3	.78	56.2	63.8	.95	51.2
	7	37.2	.39	71.6	44.6	.51	65.9	52.1	.61	60.2	59.5	.83	54.6	67.0	1.04	48.8	74.3	1.31	43.2
N. Y. No. 5.	3	15.9	.19	83.7	19.1	.25	80.4	22.3	.29	77.2	25.5	.35	73.9	28.7	.41	70.6	31.9	.48	67.2
	4	21.3	.28	78.3	25.6	.35	73.8	29.8	.44	69.5	34.0	.52	65.2	38.2	.64	60.8	42.5	.77	56.5
	5	26.6	.36	72.8	32.0	.48	67.3	37.2	.61	61.8	42.6	.77	56.4	47.8	.96	51.0	53.1	1.19	45.6
	6	31.9	.48	67.3	38.2	.64	60.9	44.6	.84	54.3	51.1	1.10	47.6	57.3	1.43	41.3	63.8	1.89	34.6
	7	37.2	.61	61.8	44.6	.84	54.3	52.1	1.14	46.6	59.5	1.56	39.0	67.0	2.23	31.4	74.3	3.18	24.9

ASSUMPTIONS:

Total Brake Pipe Volume per 35 ft. Car.......................... 660 cu. in.
Volume 8-in. Standard Cast Iron Auxiliary Reservoir..............1,620 cu. in.
Volume 10-in. Standard Cast Iron Auxiliary Reservoir.............2,440 cu. in.
Total Volume (average of 8-in. and 10-in. Equipment) per car......2,690 cu. in.
Total Volume (average of 8-in. and 10-in. Equipment)............. 1.56 cu. ft.

Displacement of compressor in cubic feet per minute.
200 lbs. steam pressure, 100 lbs. air pressure

W. A. B. 9½.. 49 cu. ft
W. A. B. 11.. 66 cu. ft
N. Y. A. B. No. 5..130 cu. ft.
W. A. B. 8½ C. C..150 cu. ft.

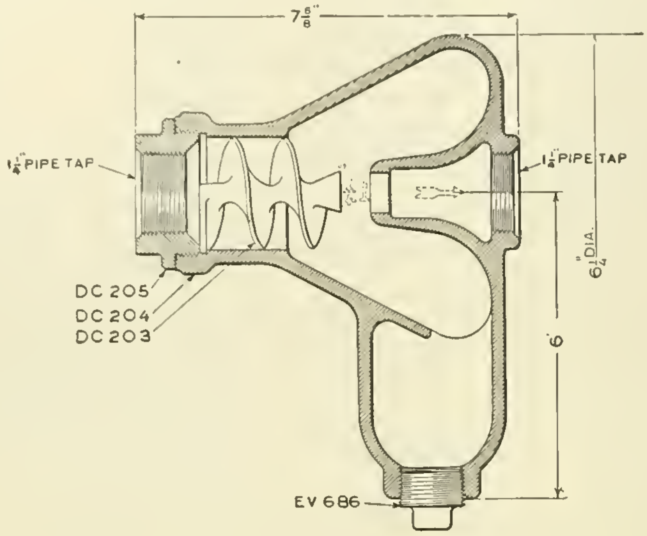
Different length trains assumed to have one-half 8-in. and one half 10-in. equipments.

NOTE.—The assumptions regarding volume of brake pipe, steam and air pressures, etc., are chosen merely as representative of average conditions which do exist in service. Individual cases will doubtless vary in one direction or another from these assumptions. Proper corrections should therefore be made if accurate data of the above character is wanted for any specific case for which the conditions are known and differ from the assumptions on which the above table is based.

Air Brake Company. As its name implies, it is intended for use in the branch of the brake pipe leading to the triple valves on freight cars, passenger cars, and to the control valve on the locomotive. It is furnished in place of the usual brake pipe strainer, and the rotary action imparted to the brake pipe air as it enters through the "rotator," drives any foreign substance, whether dust or moisture, to the outer walls of the strainer, and it is held and collected in the cup at the bottom, the clean air entering the small end of the cone, thereby protecting the brake apparatus from injury due to the presence of foreign matter.

The form of the cup at the bottom of the strainer is such as to prevent injury to the strainer from freezing, as whatever ice may be formed is free to expand.

It is not necessary to dwell upon the effect of dirt in the operating valves of a brake equipment. The plug in the bottom of the case is a standard pipe plug, and is small enough to be removed with an ordinary screw or open end wrench; its size in connection with the taper insures a ready removal and replacement.



ROTARY BRANCH PIPE STRAINER.

Applying Piston Valve Rings.

We have had a number of inquiries concerning the proper method of applying packing rings to the piston valves of the New York 5B and 6B air pumps and the Westinghouse 8½ and 10½ C. C. compressors, and the illustrations show the correct manner in which the packing rings are to be applied to the grooves of the piston valve of the New York Air Brake Company's duplex compressors. To the workman familiar with such operations the illustrations require no further comment, and to those to whom it may not be perfectly clear, we would say that the ring No. 1 has been placed between the ends of the piston in the manner that ring No. 2 is being applied. Thus it will be noted that both inside rings are to be applied from the inside of the piston, ring No. 1 to enter groove A, and ring No. 2 to enter groove B. The rings are started into the grooves from one end, and the outside rings applied in a similar manner as is practiced in applying any ordinary kind of piston ring.

Applying rings to the six central grooves of the main valve of the Cross compound compressors, is accomplished in the same manner, starting at the small end of the main valve structure.

Dean Boiler Tube Cleaner.

William B. Pierce Company, 45 N. Division avenue, Buffalo, N. Y., manufacturers of the Dean boiler tube cleaner, have just published a booklet of 20 pages, copies of which may be had on application, presenting a full description and illustrations of their tube cleaner. The device, as previously described in our pages, is a pneumatic vibrator which removes scale from the inside or outside of tubes of boilers, condensers or evaporators. It cleans from ten to thirty tubes an hour, and besides removing the scale from the water side of the tube, it removes the caked soot from the fire side, and is a very efficient tool.

FIG. 1.

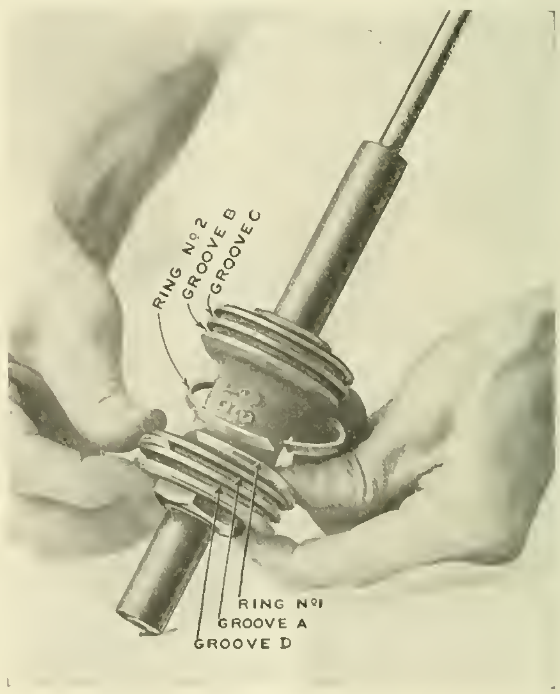


FIG. 2.

APPLYING PISTON VALVE RINGS.

New Cars for Tourists in India

The influx of large parties of "round-the-world" tourists from the United States is engaging the attention of the railway authorities of India, and to provide for their comforts a number of new, handsome, first-class compartment cars are being turned out of the Great Indian Peninsula Railway Matunga workshops, near Bombay. This road conveys the visitors for their pleasure trips to Agra and back, and also arranges for the journeys across India to Calcutta, Darjeeling, etc., etc.

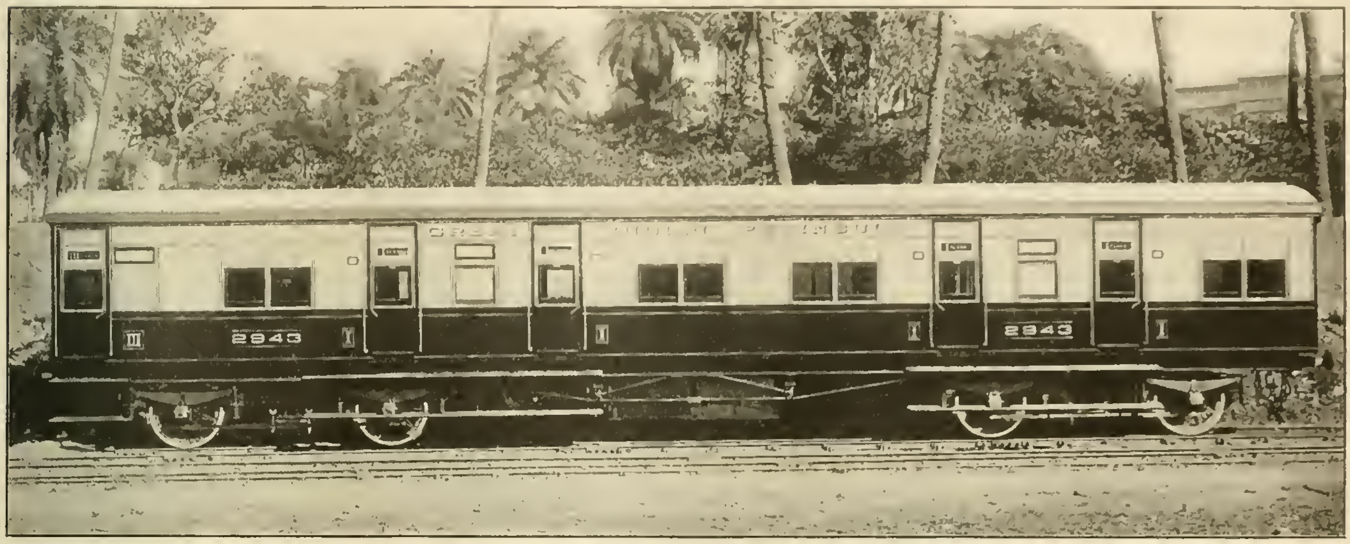
The new carriage illustrated in the photograph, has four large private compartments, each providing four berths with a small coupe to accommodate passengers' servants, a provision essential to comfortable travel in India. The total length of the car body is 62 ft., whilst its width is 9 ft. 6 in. It is built with teak framing on a steel underframe 60 ft. long; this rests on two trucks with axles placed at 10 ft. centers. The trucks are of the single bolster type with steel members and framing. The car bodies have steel upper panels with teak lower sheeting and between the two "skins" of the structure, there is a layer of heat resisting material largely composed of asbestos, which imprisons air on either side.

The compartments are upholstered in blue "buffalo" leather, and the seats are so arranged that they pull out to form berths of extra width. The upper ones have side railings similar to ships' bunks, and the provision of independent berth lights enable any occupant to recline and read in the evening without discomfort to others in the compartment. The finish of the interior is in polished teak with plain moulding, etc., worked as smooth as possible to prevent deposit of dust, and assist in cleaning. To maintain good ventilation and a cool interior, exhausting ventilators are provided above the windows, and powerful electric fans are provided. During the hot weather months it is proposed to provide electrically operated "Khus Khus" coolers, or similar appliances on a central table.

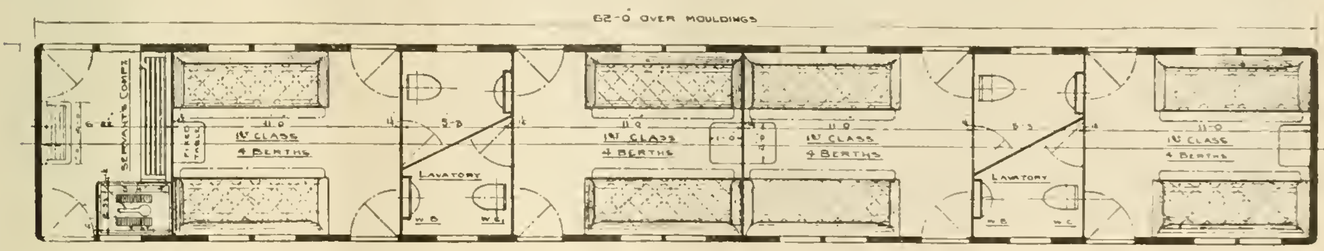
To render access to the upper berths easy, portable steps have been provided; this overcomes one of the objections passengers have to use upper berths.

The lavatories are finished in white tiled sides and mosaic floors with fittings and arrangements of the latest type; they are roomy and well finished.

Altogether, these carriages, which have been built from the designs of the carriage superintendent, Mr. A. M. Bell, who is a consistent admirer of American passenger equipment, represent a marked advance in passenger stock for Indian railways, and should prove popular during the busy season now at hand.



TYPE OF NEW CARS FOR THE GREAT INDIAN PENINSULA RAILWAY.



GREAT INDIAN PENINSULA RAILWAY CAR SHOWING PLAN OF COMPARTMENTS.

The Safety Heating and Lighting News.

The merits of the Pintsch and Electric lighting equipments of the Safety Heating & Lighting Company are so well known that a mere reference to them is sufficient, but it must not be imagined that the company are resting on their well-earned reputation. They are constantly making new devices in their special field of heating and lighting equipment. The April issue of their elegant Bulletin is full of illustrations and descriptive matter regarding mantle lamps for postal cars, safety corona globes, Pintsch mantle lamps and lanterns, electric lighting fixtures, generators and dynamo regulators, all of which possess new and admirable features. There are also reports on investigation of illumination tests conducted by the electrical department of the Baltimore & Ohio Railroad, which cannot fail to be of special interest to railroad men. Send for a copy of the Safety Heating and Lighting News (No. 6), 2 Rector street, New York.

Electrical Department

Powerful Electric Locomotives for the New York Central & Hudson River Railroad.

Ten passenger electric locomotives capable of hauling a 1,000-ton train at 60 miles per hour are to be placed in commission by the New York Central & Hudson River Railroad Co. on the electrified zone out of New York City. A very exhaustive series of tests and trial runs of an experimental locomotive of this type was recently made on the Harlem division. This locomotive was immediately put in service on the electrified section of the New York Terminal and a contract was awarded the General Electric Company for nine additional locomotives of the same design, which are now under construction.

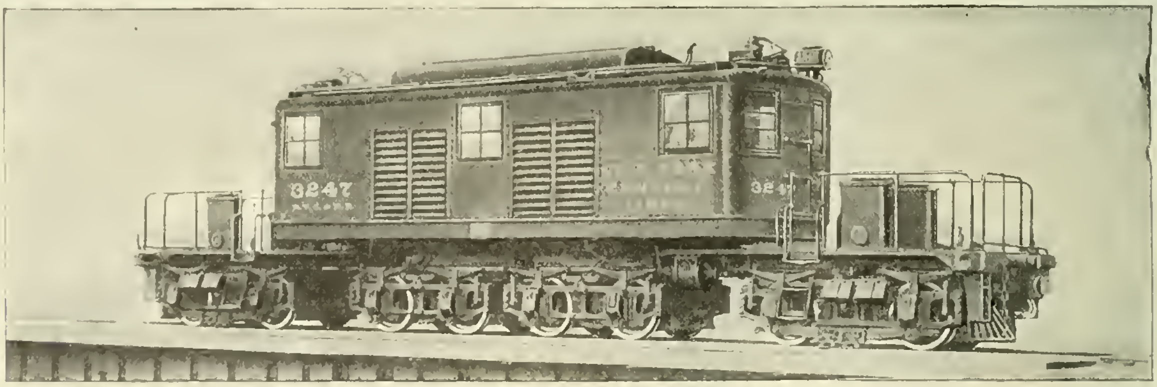
The electric locomotives in service in the terminal previous to the introduction of the new engine weigh approximately 115 tons. While the new locomotives are considerably lighter, weighing 100 tons, they are much more powerful, are provided with ample forced air ventilation and designed with a view to continuous high speed service. All the 100-ton weight is carried on motor-driven axles, while the former locomotives have but 70 tons weight on the driving wheels. In regular service they have a capacity for developing 1,400 horsepower continuously and can develop as high as 5,000 horsepower for short periods.

The original New York Central electric locomotives had guiding wheels in the form of a pony truck with 28,000 pounds on the axle. There were four driving wheels, each carrying the armature of a direct current, bipolar, gearless motor. To improve the riding qualities of this pioneer express electric locomotive, a guiding bogie truck having two axles was substituted for the pony truck. A further development in a subsequent type was to increase the distance between the guiding trucks and the rigid wheel base. The riding qualities were improved, but at a loss in the mechanical efficiency of the locomotive; for about 40 tons of surplus weight had been added and were being carried by the bogie trucks for the sole purpose of guiding the locomotive. In this latest design the guiding trucks were separated still further from the fixed wheel base and, in order to eliminate ineffective weight and to use every pound of the locomotive weight for adhesion, motors are placed on the truck axles. The lengthening out of the total wheel base necessitates the running gear to be in two halves with a spring-connected articulated joint between the frames.

At the present time the New York Central & Hudson River Railroad Co. is operating forty-seven electric locomotives in New York Terminal service. Of these, thirty-five were built in 1906 and twelve in 1908. They are all of the 115-ton 4-8-4 type and are each equipped with four GE-84 bipolar gearless motors. The new electric locomotive adopted by the company is likewise a bipolar gearless design, but it is equipped with eight GE-89 motors and is designated type 4-4-4-4. Each motor is approximately three-fourths the capacity of the GE-84 motor used on the previous engines, making the aggregate capacity of the motors on the locomotive approximately 50 per cent. greater than before and affording approximately 25 per cent. higher speed.

Since all of the axles are driving axles, these can not be distinguished as main driving or leading trucks; but they are termed for clearness rigid trucks and swivel trucks respectively. The rigid truck is built up of heavy steel castings, the side frames being of a truss pattern with heavy top and bottom members and pedestal tie bars. The end frames and centre cross frames are steel castings securely bolted to the side frames and supporting the magnet poles.

The main frame or backbone of the locomotive is a box girder built of 10-in. channels with ¼-in. top and bottom plates. It is approximately 10 inches deep by 36 inches in width and 22 feet in length. The frame is bolted to the top member of the rigid truck, and extends forward over the center plate of the leading truck and backward to the heavy hinge which connects the two halves of the frame. The main frame carries in its top plate the center pin which supports the weight of the operating cab. All these center pins are hollow and serve as air passages, the main box girder frame acting as a distributing reservoir for the air delivered from the blower in the upper cab through the upper center pins and conducting it to the eight motors below.


NEW ELECTRIC LOCOMOTIVE FOR THE NEW YORK CENTRAL LINES.

The construction of the swivel or leading truck is similar to that of the rigid truck, except that it carries a center pin and is connected to the main frame through this center pin instead of being bolted rigidly to it.

This type of design affords a long flexible wheel base with eight axles, but restricts the length of any rigid portion to not more than 6 ft. 6 in. All the axles are equipped with motors, but the magnetic circuit for each truck or pair of motors is self-contained and relates only to the two axles in that truck.

The cab, carried on the two center pins as stated, has its weight distributed between the two halves of the locomotive frame. It is the box type, 35 ft. in length and 10 ft. wide. The interior is divided into three sections. A motorman's compartment is located at either end and

contains the motorman's seat, controller, air brake, valves, bell and whistle rope handles, and such parts of the control apparatus as have to be within reach of the operating engineer. In the central section of the cab are the air compressors, blowers, contractors and rheostats, grouped so that they are conveniently accessible for inspection and repair, and separated from the direct reach or attention of the operating engineer. The advantage of this arrangement is that it removes from the sight of the engineer running apparatus which might serve to distract his attention from the actual work of handling the locomotive and which can be inspected and attended to by his assistant. This general type of construction leaves a fairly long platform on either end of the locomotive. Access to the cab is obtained through doors opening onto the platform.

The motor is practically enclosed, and the field coils are waterproofed and armored. End shields are provided for each motor, which render it dust-tight and practically water-tight. The locomotive with all eight motors working has a capacity of 13,500 lbs. tractive effort at 54 miles per hour for one hour, and 10,000 lbs. tractive effort at 60 miles per hour continuously. The motors are electrically connected in pairs, each pair handled as a four motor equipment in the three combinations, namely, series, series parallel and parallel.

Current is collected by eight underrunning third rail shoes, or by two overhead trolleys when on gaps on the third rail.

The principal data and important dimensions applying to the locomotive are the following:

Length inside of knuckles—55 ft. 2 ins.
Length over cab—33 ft.
Height over cab—12 ft. 8 ins.
Height with trolley down—14 ft. 6 ins.
Height with trolley running—15 ft. 1 in.
Width over all—10 ft.
Rigid wheel base—5 ft. and 6 ft. 6 ins.
Total weight—200,000 lbs.
Weight per axle—25,000 lbs.
Dead weight per axle—6,395 lbs.

Interurban Service on the Lackawanna & Wyoming Valley Railroad.

A high-speed service equal to, if not better, than that given by the paralleling steam roads, is operated between Scranton and Wilkes-Barre, Pa., by the Lackawanna & Wyoming Valley Railroad Company. Competition with steam roads between the two terminals is keen, but because of the high-class and frequent service furnished by the interurban line, its traffic is very heavy.

Local and limited trains are run. Local trains on a twenty minute headway, and limited trains every hour, the running time being forty-one minutes and thirty minutes respectively.

Single car trains are used until shortly after noon when two car trains are used and often four car trains are run. This flexibility of operation is possible, as each car is a motor car and as many as desired can be operated, all being controlled by one man at the head end. Thus the amount of rolling stock in operation is efficiently adjusted to the demands of the traffic without delays or changes in the schedule and very little increase in operating expenses.

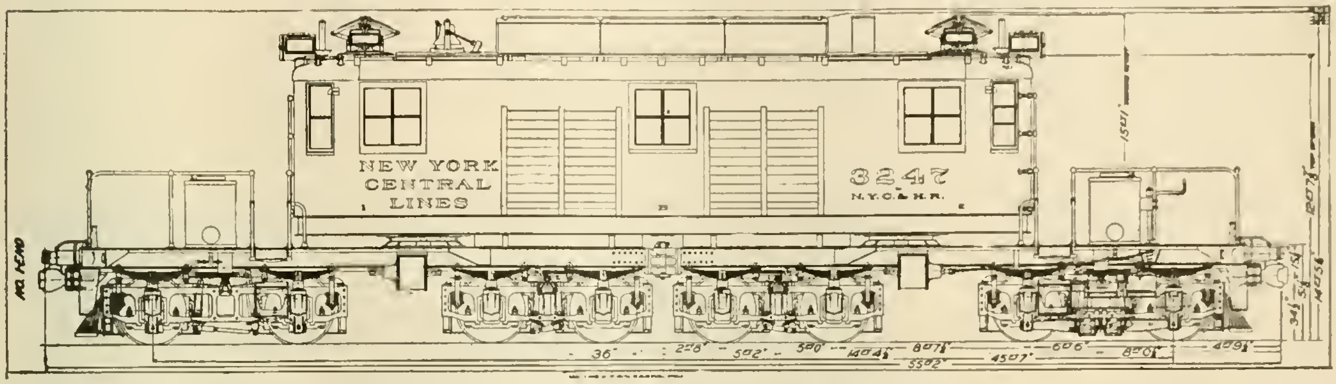
Besides the 34 cars which are all equipped with two Westinghouse motors, each of 150 h. p., there are 2 locomotives used for switching and freight service.

Battery-Charging Motor-Generator Sets for Railway Signalling.

Bulletin No. 4085, just issued by the General Electric Company, describes more or less briefly that company's battery-charging motor-generating sets for railway signaling. The bulletin should be of service to railway men.

Large Electric Turbo-Generators.

Electric power is being generated by larger and larger units from year to year. It was only a few years ago, in 1904, that the Westinghouse company built the largest turbo-generator at that time, of approximately 6,000 k.w. or 8,000 horsepower. Units now of 30,000 horsepower are built by the same company. Two large units of approximately 26,000 h. p. have recently been ordered by the West Penn Traction Co., Pittsburgh.



ELEVATION VIEW OF THE POWERFUL NEW ELECTRIC LOCOMOTIVE FOR THE NEW YORK CENTRAL LINES.


FOUR-CAR ELECTRIC TRAIN ON THE LACKAWANNA & WYOMING VALLEY R. R.

Cloth Pinions.

Rawhide, paper and other materials have been extensively used with certain measures of success, but nothing of the kind in any respect approaching the effectiveness of cloth pinions has heretofore been produced. The strength is equal to that of any other non-metallic gearing, and by virtue of a measure of elasticity, they run safely in any service within the limit of strength of similar cast iron gears.

Improvements in Constructing, Painting and Cleaning Steel Passenger Coaches

The American Society of Mechanical Engineers' held a very interesting meeting in New York last month, which was largely attended by a representative gathering of mechanical engineering and railroad men. The subject of steel passenger car design was discussed at considerable length, the basis being the presentation of no less than thirteen short papers, all bearing on some particular phase of the subject, and all written by experts in their various departments.

Among the principal papers were that presented by Mr. H. H. Vaughn, assistant vice-president of the Canadian Pacific, who briefly outlined the new problems that the change from wood to steel car construction had brought forward. Wooden passenger cars had developed along uniform lines. The varieties of framing were few and the differences unimportant, while the introduction of steel in freight cars resulted in the abandonment of designs that had become standardized and the introduction of many new types. In freight cars the principal problem, other than that of obtaining satisfactory designs, had been the extent to which it was advisable to use composite or all-steel construction. In passenger cars the types will not likely be changed by the substitution of steel for wood. The single problem as to whether greater framing strength was necessary brought up the question of side framing or center-girder type, and is important, because the weight of passenger cars was already excessively heavy per passenger, even with wood construction, and the use of steel has increased the weight from 10 to 20 per cent. Side-girder cars had so far a decided advantage over the center-girder type, in their lighter weight and greater strength in case of accident. This may lead to its adoption on roads where the lesser weight is of importance. In the matter of sheathing cars, the cost and weight will likely prevent its general use.

In the matter of inside finish, there is no general objection to the use of wood. It is more capable of ornament and a better insulator. There is little or no difference in cost, and opinions are much divided among car builders and railroad men. The importance of strengthening the ends of cars by the use of steel had met with universal approval, while the floors, constructed of metal covered with a flexible cement was a step in the right direction. On the Canadian Pacific an underfloor was used, covered with insulating material and the cement was also covered with cork ½ in. in thickness. A car floor protected in this way was warmer than a wooden car. The superiority of the steel car in this regard, as well as in the more important element of safety was beyond question.

Mr. C. D. Young, engineer of tests of the Pennsylvania, presented an interesting paper on the painting of steel passenger cars. Much importance was placed on the thorough cleaning of the surfaces to be painted. Sand-blasting, wire brushes and emery cloth were essential to complete work, the sand-blasting being confined to the outside. One coat of suitable primer was sufficient on truck parts, before assembling. Afterwards, all surfaces exposed to view on trucks except wheels, should be covered with two coats of truck enamel. Details of the preparation of the underframes and superstructures were also given, which embodied the results of repeated experiments. In underframes where metal bears on metal, two coats of a non-inflammable preservative were necessary, and all exposed surfaces should have a third coat of the preservative applied.

In regard to the outside sheeting, with letter and deck plates, they should be covered with a coat of surfacer and glazed with surfacer composition, no less than four coats of surfacer being added, and rubbed down with linseed oil and emery cloth, then two coats of the color material desired being added, and after striping and lettering, three coats of finishing varnish were required. A heavy coat of protective paint was necessary on the roof, followed by one coat of a mixture of three parts of mixed ground color and one part of the protective coating. Details of interior painting and finishing were also given, embracing the application of coats of primer, drying, surfacing, puttying and glazing with additional coat of primer and emery cloth rubbing, coloring, varnishing, and finishing with rubbing with oil and pulverized pumice stone, the various applications occupying a period of eighteen days.

In spite of all these preparations and applications it was found that as the linear expansion of steel is much more than that of wood the tendency of the interiors of the cars to show cracks and checks was very great. These defects extended through to the surfacer. These conditions developed on an average of six months' service, showing that a new system of painting was necessary, and a more elastic paint would have to be used for interior finishing. Extensive experiments were made on special panels dried in ovens, and the result was that marked improvements were expected in the near future. To test the merit of the experiments an oven has been designed and built at the Altoona shops of the Pennsylvania Railroad sufficiently large to hold a car. The oven is lined with ¼ in. steel plates on the inside and the outside with galvanized iron. A 3 in. space between the sheets is filled with magnesia lagging. Into this oven a row of steam pipes is admitted at a pressure of about 100 pounds per square inch, so that a temperature of over 250 deg. may be maintained during the drying or baking process. As each successive coat of primer and sur-

CLEANING THE EXTERIOR OF COACHES ON THE PENNSYLVANIA WITH SPECIAL SOAP AND CHEMICALS.

facing and coloring is applied the car is removed from the oven and allowed to cool sufficiently before the application of the new coat, and at the final varnishings, the temperature of the oven is reduced to 120 deg. F. at the start to 150 deg. F. at the finish. All the work may be accomplished in one week. The oven has been in operation since the beginning of the present year and the results so far justify the expectation that the checks and cracking will be considerably lessened, if not entirely removed. The saving in time alone is considerable, and the assurance of a longer life of material applied, together with less of material, while the general appearance of the completed work is claimed to be better.

All of the papers were of an interesting kind, and it was matter of regret that there was not time to read and discuss all of the papers. Much favorable comment was made on the enterprise shown by the Pennsylvania in regard to the improvements in car construction, painting, decorating and cleaning. In the latter operation it may be remarked that the traveler, as he boards the train which is shining and spotless inside and out, does not stop to think that a few hours before these same cars were returning from a run dusty and travel-stained; that the seats and carpets which look so fresh and new have lately borne the traces left by other travelers. If he could stay on board after the passengers are discharged at Pennsylvania Station in New York, and slide under Manhattan Island and the East River with the empty train, he would meet a surprise.

First the carpets are removed. They are taken to a platform constructed for the purpose and every particle of dust removed by the suction of a vacuum process. On the car also compressed air has been at work. The "blowers," as the men are called, have turned a purifying, all-pervading stream from their hoses into every nook and cranny. The seats are gone over and the dust swirling out of the windows gives the impression that the car is afire. When the nozzle is turned on the window itself myriad particles of dust and cinders take flight from their hiding places around the sash.

Next comes a man with a mop. The floors of the steel cars used by the Pennsylvania are much of a mixture of cement and ground cork and are much easier to clean than wood. After they have been thoroughly scrubbed women with cloths go over the steel "woodwork," polishing it until to the shining point. Finally, after the carpets are laid, there is another careful dusting with cloths and the car is ready for another trip.

CLEANING THE BACKS OF SEATS IN PASSENGER COACHES ON THE PENNSYLVANIA WITH COMPRESSED AIR.

The problem of exterior cleaning is being studied very carefully by the Pennsylvania. Experiments are being made with different solutions for this work, the principal ingredients of all being oil and soap. Every solution is tried out for a period of three years. Every time a car is cleaned it is recorded, and when it goes to the shops at Altoona to be overhauled the experts there compile data from these records to be used in determining which solution is the most effective and economical.

New Testing Plant.

The first locomotive to be tested in the new locomotive laboratory of the College of Engineering of the University of Illinois has arrived. The locomotive is the Illinois Central Railroad's large, modern freight engine, No. 958. It is of the consolidation type. Its total weight, with the tender, is 182 tons, of which 100 tons are supported on the eight driving-wheels. During the operations of testing, the locomotive driving-wheels will rest upon wheels instead of rails. These supporting wheels are arranged so that they may be shifted to suit any spacing of drivers, and they are free to revolve about axles resting in large bearings. The resistance is supplied by hydraulic brakes attached to each end of the supporting axles. In this way the reciprocating and revolving parts of the locomotive may be run at any desired speed, exactly as in ordinary operation, while any actual movement of the locomotive itself, along the track, is prevented by a heavy anchor or dynamometer at the rear, which also serves to measure the draw-bar pull. While thus operated, it may be tested with the same facility as a stationary steam plant.

Grinding Wheels.

There are two reasons why a wheel appears softer in the center. The surface speed decreases in proportion to the diameter when the wheel wears smaller. If the surface speed decreases, the wheel will act softer, and a larger quantity of abrasive be required to grind a certain quantity of materials. By decreasing the diameter, the thickness of layer worn off increases; in other words, wearing off the same quantity of abrasive will decrease the diameter faster when the diameter of the wheel is small than when it is large.

At a meeting of the Board of Directors of the United States Light & Heating Company held in New York last month, Mr. Charles A. Starbuck was elected chairman of the Board of Directors. Mr. J. Allan Smith, president; Mr. Frank P. Frazier, vice-president; Mr. William P. Hawley, vice-president, and Mr. A. H. Ackermann, general manager. Mr. W. S. Crandell is secretary of the company, with offices at 30 Church street.

The Horace L. Winslow Company, contractors and heating experts, have recently found it necessary, on account of expansion resulting from increase of business, to move into new and larger offices at 990 Old Colony Building, Chicago. They are well known for their installations of locomotive washout plants and water recovery systems.

The Watson-Stillman Company has moved its Chicago office from 449, The Rookery, to the McCormick Building, Chicago, Ill.

Items of Personal Interest

Mr. J. A. Burchill has been appointed foreman of shops of the Chicago & Northwestern at Waseca, Minn.

Mr. G. W. Keller has been appointed general foreman of the Norfolk & Western at Portsmouth, Ohio.

Mr. G. E. Hendricks has been appointed general foreman of the Chicago & Eastern Illinois at Mitchell, Ind.

Mr. C. M. Hitch has been appointed general foreman of the Cincinnati, Hamilton & Dayton at Lima, Ohio.

Mr. D. S. Littleholes has been appointed master mechanic of the Northern Pacific, with office at Jamestown, N. D.

Mr. A. Pye has been appointed road foreman of engines of the Grand Trunk Railway, with office at Ottawa, Ont.

Mr. Q. E. Herricks has been appointed general foreman of the Chicago & Eastern Illinois, with office at Mitchell, Ill.

Mr. Charles W. Crapp has been appointed general foreman of the Chicago & Northern, with office at Escanaba, Ill.

Mr. N. C. Bettenberg has been appointed master mechanic of the Great Northern, with office at Crookston, Minn.

Mr. W. P. Kinney has been appointed master mechanic of the Wichita Falls route, with office at Wichita Falls, Tex.

Mr. F. Studer has been appointed master mechanic of the Chicago & Eastern Illinois, with headquarters at Evansville, Ill.

Mr. G. G. Martin has been appointed master mechanic of the Aberdeen & Rock Fish Railway, with office at Aberdeen, N. C.

Mr. J. W. Small has been appointed superintendent of motive power of the Seaboard Air Line, in place of Mr. A. J. Poole, resigned.

Mr. C. Black has been appointed foreman of the Lake Erie & Western shops at Rankin, Ill., in place of Mr. R. H. Zork, resigned.

Mr. W. E. Dewitt has been appointed road foreman of engines of the New York Central & Hudson River, with office at East Buffalo, N. Y.

Mr. A. E. McMillan has been appointed general foreman of the Baltimore & Ohio South Western at Cincinnati, Ohio, in place of Mr. G. A. Bowers.

Mr. Fred Hooker has been appointed superintendent of locomotive fuel service of the St. Louis, Brownsville & Mexico, with office at Keysville, Tex.

Mr. P. Dickson has been appointed foreman of the mechanical department of the Stephenville, North & South Texas Railway, with office at Comanche, Tex.

Mr. A. Eugene Michel and staff, advertising engineers, have removed from 21 Park Row, New York, into larger offices, Rooms 1001-7 Woolworth Building.

Mr. W. L. Kellogg, superintendent of motive power of the Missouri, Kansas & Texas, has had his headquarters transferred from Parsons, Kan., to Denison, Tex.

Mr. G. Newman, formerly master mechanic of the Union Pacific, at Sharon Springs, Ark., has been transferred to a similar position on the same road at Denver, Colo.

Mr. D. S. Terry has been appointed constructing engineer of the Cleveland, Cincinnati, Chicago & St. Louis, and Peoria & Eastern, with headquarters at Cincinnati, Ohio.

Mr. W. J. McLean, formerly master mechanic of the Duluth, Winnipeg and Pacific, has been appointed master mechanic of the Kettle Valley, with office at Penticton, B. C.

Mr. L. J. McDonald has been appointed road foreman of equipment of the Chicago, Rock Island and Pacific, with office at Elden, Iowa, in place of Mr. J. C. Rhodes, resigned.

Mr. Matthew W. Reagan has been appointed road foreman of engines on the New York Central Lines, with headquarters at West Albany, in place of Mr. W. P. Davis, promoted.

Mr. Harry W. Joyce, formerly roundhouse foreman of the Union Pacific, at Denver, Colo., has been appointed master mechanic on the same road, with office at Sharon Springs, Kans.

Mr. Erward A. Park, formerly master mechanic of the Union Pacific, at Denver, Colo., has been appointed to a similar position on the Peoria and Pekin Union, with office at Peoria, Ill.

Mr. Frank Hopper, formerly master mechanic of the Dakota division of the Chicago, Rock Island & Pacific, has been appointed master mechanic of the Duluth, Winnipeg & Pacific, with office at West Duluth, Minn.

Mr. E. G. Haskins has been appointed master mechanic of the Denver & Rio Grande at Salida, Col., and Mr. A. S. Teaque has been appointed assistant master mechanic on the same road, with office at Hepor, Utah.

Mr. Henry Jungermann, formerly with the motive power and inspection department of the Harriman Lines, has been appointed railway representative of Tate-Jones & Co., manufacturers of shop furnaces, Pittsburg, Pa.

Mr. Joseph Wood, first vice-president of the Pennsylvania, has been elected a director of the company to fill the vacancy caused by the death of Mr. James McCrea, whose term of office would have expired in 1914.

Mr. John G. Greiner, formerly general foreman of the shops of the Cincinnati, Hamilton & Dayton, at Lima, Ohio, has been appointed master mechanic of the San Pedro, Los Angeles & Salt Lake, with office at Salt Lake City, Utah.

Mr. L. A. Richardson, formerly master mechanic of the Chicago, Rock Island and Pacific, at Chicago, Ill., has been appointed mechanical superintendent of the third district, with office at El Reno, Okla., in place of Mr. C. M. Taylor, who has been transferred.

Mr. N. S. Airhart has been appointed master mechanic of the Missouri, Kansas & Texas, with office at Parsons, Kan. Mr. H. L. McLow has been appointed master mechanic of the same road, with office at Waco, Tex., and Mr. R. R. Bates has been appointed general foreman on the same road at Parsons, Kan.

Mr. R. L. Stewart, formerly master mechanic of the Chicago, Rock Island & Pacific at Trenton, Mo., has been transferred to Chicago, Ill., where he will have jurisdiction over the Chicago Terminal and the Illinois divisions, and Mr. E. J. Harris, formerly master mechanic of the same road at Armondale, Kan., has been transferred to a similar position at Trenton, Mo.

Mr. J. M. Whalen has been appointed master mechanic of the Iron Mountain, at McGhee, Ark., in place of Mr. W. A. Conley, who has been appointed master mechanic on the Missouri Pacific, at Van Buren, Ark., in place of Mr. W. A. Bedall, who was transferred to Jefferson City, Mo., as master mechanic on the same road, and Mr. C. W. Burkheimer has been appointed division foreman on the same road at Texarkana, Ark.

Mr. M. G. Condon, Mr. D. C. Hitchner, Mr. H. D. Griffith and Mr C. O. Ralph, formerly with H. B. Underwood and Company, Philadelphia, have formed a partnership with a view to establish a new company. The business of manufacturing portable cylinder boring bars and other high-class portable tools will be continued by H. B. Underwood and Company, 1025 Hamilton street, the same location where it has been since 1870.

Mr. W. H. Wunderle has been appointed roundhouse foreman of the Chicago & Alton, at Bloomington, Ill. Mr. Frank Coe has been appointed night foreman, and Mr. W. H. Davis, superintendent of air brakes at the same place, while Mr. M. R. Vasconcelles has been appointed roundhouse foreman at Springfield, Ill. Mr. Edward Grindrod, demonstrator of apprentices, and Mr. I. H. Hicock, general foreman at Bloomington, Ill. Mr. Hicock succeeds Mr. Geo. Greeg.

Mr. F. C. Hamilton has been appointed general foreman of the Atchison, Topeka & Santa Fe at Argentine, Kan. Mr. Charles Johnson has been appointed foreman at Seligman, Ariz. Mr. David Hopkins has been appointed road foreman at Fresno, Cal. Mr. J. C. Levy has been appointed to a similar position at San Bernardino, Cal., and Mr. C. McCarley has also been appointed to a similar position at Albuquerque, N. M., all on the Santa Fe.

Mr. T. W. Callahan, formerly master mechanic of the Mesabi division of the Great Northern, has been appointed master mechanic of the Kalispell division, with office at Whitefish, Mont. Mr. John Lloyd has been appointed road foreman of engines of the Montana division of the same road, and Mr. Wm. MacKenroth has been appointed locomotive fireman on the same road at Minot, N. D.

Mr. C. A. Ralston has become associated with the Rumsey Car Door

W. S. CARTER,
President Brotherhood of Locomotive Firemen and Enginemen.

and Equipment Company, Chicago, Ill., in the capacity of vice-president and general sales manager. Mr. Ralston has had over twenty years' experience as a civil engineer and operating official with some of the leading industrial concerns in America. He was for some years sales manager of the Lima Locomotive Company and latterly with the Hicks Locomotive and Car Works. Mr. Ralston is an engineer of acknowledged ability and the Rumsey Car Door and Equipment Company are to be congratulated on the new and important addition to their excellent staff of officials.

C. A. RALSTON.

Mr. Elisha Lee, assistant to general manager Pennsylvania Lines East, and chief of counsel for Eastern railroad companies in the recent arbitration proceedings was born in Chicago, Ill. In 1877, when he was seven years old, his family moved to Trindad, British West Indies, where he remained until 1883. He then went north to attend the public schools at Binghamton, N. Y., and "The Gunnery," Washington, Conn. He was graduated from the Massachusetts Institute of Technology in the class of 1893. Mr. Lee entered the service of the Pennsylvania Railroad Company in 1892 as rodman in the office of the division engineer of the Tyrone Division. From 1895 to 1897 he was on a leave of absence attending to some personal business. He was appointed Assistant Supervisor in April, 1899, and served in that capacity on various divisions until April, 1901, when he was appointed Supervisor. In August, 1903, he was promoted to Assistant Engineer in the Maintenance of Way Department, and advanced to Principal Assistant Engineer of the Philadelphia, Baltimore and Washington Railroad Division in April, 1907. In March, 1909, he was appointed Superintendent of the New York, Philadelphia and Norfolk Railroad, and in March, 1911, was made Assistant to the General Manager of the Pennsylvania Lines East of Pittsburgh and Erie. Mr. Lee has been a close student of railroad operations, and his association with many of the leading railroad men of our time has eminently fitted him for a high place in railroad work. He is a graceful and scholarly speaker and marshals his facts and figures with the skill of a mathematician.

Mr. W. S. Carter, president of the Brotherhood of Locomotive Firemen and Enginemen and Chief of Counsel for for the Brotherhood in the recent arbitration proceedings is a native of Texas, and entered railroad service as a fireman on the Central Montgomery railway, now the Beaumont Division of the Gulf, Colorado and Santa Fe railway in 1879. He was some time engaged in the baggage department of the International and Great Northern railroad, and in 1885 returned to locomotive service on the same road. From that period until 1894 he was occupied on various western railroads as fireman and locomotive engineer. Meanwhile he had shown considerable aptitude as a forceful writer on economic and other subjects, and at the Harrisburg convention in September, 1894, he was elected editor and manager of the Brotherhood's Magazine. He filled the position with much approval for ten years, and in 1904 he became grand secretary and treasurer of the Brotherhood. At the Columbus convention in 1908 he was elected President of the Brotherhood, the duties of which he has ably filled up to the present time. Some years ago Mr. Carter made a trip to

ELISHA LEE,
Assistant to General Manager, Pennsylvania Lines.

Europe and was received with much favor among the railroad societies in Great Britain. He is a forceful and eloquent speaker, a keen and close reasoner, a ready and resourceful debater, and his flashes of wit and humor give a charm to his personality that is eminently engaging.

Award of Arbitrators on Firemen's Demands

The Board of Arbitrators appointed to consider the demands of the locomotive firemen on their employers which was composed of W. W. Atterbury, vice-president of the Pennsylvania Railroad; Judge W. L. Chambers, and Vice-President Phillips, of the Brotherhood of Locomotive Firemen and Enginemen, submitted their award on April 23.

The award is a compromise, for the full increase of wages demanded was not granted, but the rates established constitute an average advance throughout the territory of from 10 to 12 per cent. The award was unanimous on the part of the three arbitrators. The award is regarded as a victory for the firemen, and we understand that W. S. Carter and other officials of the Firemen's Brotherhood consider that the firemen have been fairly treated. There appears to be no protest from the railroad companies, so that harmony prevails.

One of the most beneficient features about the settlement of this dispute is that the principle of arbitration is vindicated. Among wage earners and among the public generally there is decided scepticism concerning the efficacy of arbitration in settling disputes between capital and labor. This award made unanimous by the arbitrators will do much to convince the parties to other labor disputes that arbitration is likely to prove satisfactory in awarding justice.

The following table shows the wages asked by the men and those fixed by the award, the wages asked on the larger freight engines being for each of two firemen, while the award is for one except when the employment of two is decided upon.

PASSENGER SERVICE.

Weights of locomotives in pounds on drivers.	Demand.	Award.
Less than 80,000 lbs.......	$2.55	$2.45
80,000 to 100,000 lbs......	2.65	2.50
100,000 to 140,000 lbs......	2.80	2.60
140,000 to 170,000 lbs......	3.00	2.70
170,000 to 200,000 lbs......	3.20	2.85
200,000 to 250,000 lbs......	3.40	3.00
250,000 to 300,000 lbs......	3.60	3.20
300,000 to 350,000 lbs......	3.80	3.40
All engines over 350,000 lbs. on drivers	4.00	3.60
Mallet engines regardless of weight on drivers....	4.00	4.00

FREIGHT SERVICE.

	Demand.	Award.
Less than 80,000 lbs.......	$2.80	$2.75
80,000 to 100,000 lbs......	3.00	2.85
100,000 to 140,000 lbs......	3.20	3.00
140,000 to 170,000 lbs......	3.35	3.10
170,000 to 200,000 lbs......	3.50	3.20
200,000 to 250,000 lbs. (2)..	3.35	3.30
250,000 to 300,000 lbs. (2)..	3.50	3.55
All engines over 300,000 lbs. on drivers (2)......	3.50	4.00
Mallet engines regardless of weight on drivers (2)	3.50	4.00

SPECIFIC WAGE ALLOWANCES.

The award provides that where two firemen are employed on an engine the rates shall be $2.75 and $3 a day, according to weight on drivers, as against $3.35 and $3.50 requested. In switching service the rates awarded are $2.50 and $2.60 as against $2.60 and $2.80 asked, although the board concedes $4 on Mallet engines—two engines coupled together—which would have come in on the $2.80 class in the demand.

Hostlers receive $2.40, $3.25 and $2.50, according to class service, as against $3.75 and $2.50 asked, the board having made a different classification of such service from that proposed by the firemen.

In electric service the term "fireman" for the second man on a locomotive, is changed by the board to "helper." "Helpers" in passenger service will receive $2.50, as against $3 asked; in freight service, $2.80, as against $3.25, and in switching service $2.50, as against $2.80.

The contention of the railroads that men in electric service should cover more miles to constitute a day's work, was disregarded by the board, which makes no distinction from steam service in this respect. The board also adopted, without change,, the firemen's proposal that "all working conditions applicable to locomotive firemen in steam service will apply to helpers in electric service." This, too, is a big gain for the men, since the engineers' arbitration, in which the board left the problems of electric service to be worked out later.

The board also granted the firemen's contention that men in pusher and helper service, mine runs, work, wreck, belt line, and transfer service should receive the same rates as in through freight service. Those in local freight service are to get 15 cents more than in through freight, instead of 25 cents, as requested. The board also adopted the firemen's demand that the roads should keep posted bulletins showing the weight on drivers of all locomotives in service, so the men could tell to what wages they were entitled.

The board fixed a day's work at ten hours or less, or 100 miles or less, which is the general practice, and was not contested. It also adopted the firemen's proposal that the time for which they should be paid should begin when required to report for duty and end when the engine was delivered at the point designated. The firemen had complained that they were frequently called to work a long time before the train was actually sent out. Increases were also granted in overtime in the various classes of service.

The award also relieves firemen of cleaning engines, which on some of the roads is now done by roundhouse employees. Lubricators are to be filled, headlights, markers, and other lamps cared for, and all supplies placed on engines at points where roundhouse or shop forces are maintained, relieving firemen on some of the roads of duties of which they complained.

The World's Rail Way.

High art to portray the development of the prosaic details of transportation machinery is what people find in The World's Rail Way, by J. G. Pangborn. This is one of the greatest triumphs of the printer's and engraver's art ever produced. Five hundred copies of the book were said to have cost $50,000, the Baltimore & Ohio Railroad Company footing the bill. Some copies of the book were purchased by the Angus Sinclair Company, and half a dozen remain on hand. We are selling them for five dollars each. Every railroad man with pride in his business ought to possess the book. Don't all order at once.

Quite an Echo.

Emerson Hough is very fond of outdoor life, and many is the good story which he tells around the campfire at night. While camping out in the Adirondacks with a party of friends, the conversation turned on echoes and how easily they might be heard. Many good stories were told, but the following statement by Mr. Hough was acknowledged the best. "Out in the Rocky mountains it takes eight hours to hear the echo of your voice. When I camp out there and just before I pull the blanket around me for the night, I shout out, 'Time to get up!' and—do you believe it?—the echo wakes me next morning!"

Too Much Dance.

A woman hailed a tramcar conductor in an excited manner customary with many of her sex, but the car did not stop until some of the people inside called the attention of the conductor to the fact that the woman wished to enter. As she got in she glared at the man indignantly. "Why didn't you stop the car for me?" she snapped. "How was I to know you wanted to get in?" said he. "Didn't you see me swinging my arms, and jumping up and down, and waving my umbrella?" "Of course! Could anyone help seeing you?" "Then why didn't you stop?" "Because I thought you were dancing to that organ!"

RAILROAD NOTES.

The Georgia is reported in the market for six locomotives.

The Susquehanna & New York has for sale a number of tank cars.

The Iowa Central, according to report, has ordered 700 freight cars.

The Seaboard Air Line is in the market for 10,000 tons of rails.

The New York Central Lines are in the market for 180 locomotives.

The Denver & Rio Grande has ordered 10,000 tons of 85-lb. and 90-lb. rails.

The Boston & Maine is in the market for 1,500 gondola cars and 4,500 box cars.

The Wabash has asked permission of the courts to purchase thirty locomotives.

The Maine Central is said to be in the market for 1,200 tons of steel for bridge work.

The Minneapolis & St. Louis will purchase freight car equipment in the near future.

The Lehigh Valley has ordered 25 locomotives from the Baldwin Locomotive Works.

The Quebec Central has ordered from the Canadian Locomotive Co. four mogul locomotives.

The St. Louis & San Francisco is in the market for 1,000 box cars and 1,000 gondola cars.

The Grand Trunk Railway has ordered twenty-five locomotives from the Baldwin Locomotive Works.

The Seaboard Air Line is reported in the market for five steel dining cars and 10 passenger coaches.

The Pittsburgh & Shawmut has ordered five mikado locomotives from the Baldwin Locomotive Works.

The Missouri Pacific is reported to have ordered 800 tons of bridge steel from the American Bridge Company.

The Boston & Maine is in the market for twenty switching locomotives and forty Pacific type locomotives.

The Northwestern Railway of Brazil has ordered four mogul locomotives from the Baldwin Locomotive Works.

The Chicago, Peoria & St. Louis, it is reported, has ordered 200 box cars from the American Car & Foundry Company.

The Louisiana & Arkansas is said to be in the market for 100 steel underframe gondolas and 200 steel underframe box cars.

The Atlantic Coast Line has ordered twenty-five locomotives from the Baldwin Locomotive Works, nine of which are for switching use.

The Norfolk Southern has ordered four consolidation locomotives and ten ten-wheel locomotives from the Baldwin Locomotive Works.

The Chicago, Peoria & St. Louis has ordered 200 box cars and some miscellaneous equipment from the American Car and Foundry Company.

The Havana Central is reported to have ordered 450 flat cars from the American Car & Foundry Company, and is still in the market for fifty coal cars.

The Boston Elevated has ordered thirty passenger cars from the Pressed Steel Car Company, and twenty-five passenger cars from the American Car & Foundry Company.

The New York Central & Hudson River, it is reported, is having forty-three consolidation locomotives converted into mikados by the American Locomotive Company.

The Harriman Lines are expected to place orders for 66 coaches, 45 chair cars, nine diners, seven observation cars, six buffet and baggage cars, 26 postal cars and 42 baggage.

The New York, Chicago & St. Louis has awarded contract for 65-lb. rails and accessories to lay about twenty-five miles of track, to the National Iron & Steel Company, St. Louis, Mo.

The Norfolk Southern has ordered 300 box cars and six caboose cars from the Mt. Vernon Car & Manufacturing Company and 160 flat cars from the American Car & Foundry Company.

The Baltimore & Ohio has ordered 1,500 all-steel, 50-ton hopper cars. This order was divided equally among the Pressed Steel Car Company, the American Car & Foundry Company and the Standard Steel Car Company.

The Louisville & Nashville has ordered

750 steel underframes from the Mt. Vernon Car Manufacturing Company, 600 from the Pressed Steel Car Company, and 100 from the Bettendorf Axle Company.

The New York, Chicago & St. Louis has ordered from the American Locomotive Company eleven ten-wheel locomotives, six switching locomotives and six consolidation locomotives.

The Wabash has asked authority of the courts to purchase 200 hopper cars, 750 automobile cars, 20 passenger cars, 1,000 steel underframes for box cars, and 1,000 steel underframes for stock cars.

The Norfolk Southern has ordered 300 box cars and six caboose from the Mt. Vernon Car Manufacturing Company, 160 flat cars and eight passenger cars from the American Car & Foundry Company, and 40 ballast cars from the Rogers Ballast Car Company.

The Pennsylvania Lines West are reported to have divided their recent orders for passenger equipment: The Pressed Steel Car Company, 25 coaches; The Standard Steel Car Co., 10 coaches and 5 dining cars, and the American Car & Foundry Company, 7 coaches, 31 passenger and baggage, 5 baggage and 2 mail cars.

The Baltimore & Ohio has placed a contract for 1,500 steel hopper cars with three companies, each company to build 500 cars each. These companies are the American Car & Foundry Company, the Pressed Steel Car Company, and the Standard Steel Car Company. The new equipment will represent an expenditure of nearly $1,500,000.

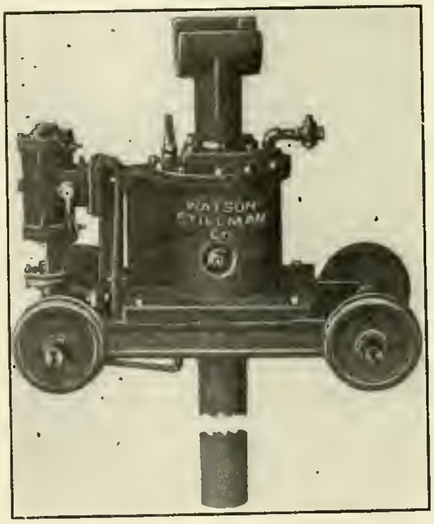
The Havana Central has ordered four Pacific type locomotives from the American Locomotive Company. These locomotives are to be equipped with superheaters. The dimensions of the cylinders will be 20 x 26 ins., the diameter of driving wheels will be 62 ins., and the total weight in working order will be 173,000 pounds.

Improvement in Hydraulic Pit Jacks.

The Watson-Stillman Co., New York City, has recently made an important change in the construction of its hydraulic pit jacks that has grealty improved these tools. The old-fashioned hand-operated pumps have been replaced by pumps driven by air engines that are attachable to any style or size of jack manufactured by the above company.

The use of compressed air at about 90 pounds per square inch pressure has become so universal in roundhouses and railroad shops that the air driven engine adapts itself admirably to modern shop equipment. To make the power connection it is merely necessary to run a rubber hose or other flexible tubing from the shop air main to the pump engine just as is done in the case of pneumatic riveters. The operating valves can be placed in any convenient position which will invariably permit the foreman or man in charge to operate the lift in addition to directing the work of his men. The use of this air engine therefore eliminates one man—the pump operator—from the crew.

By the use of air power the speed of operation is very greatly increased. When it is desired to raise the saddle up to the work, air is admitted directly into the top of the resevoir forcing the water into the cylinder and lifting the ram at almost any desired speed. As soon as the load becomes too great



IMPROVED PIT HYDRAULIC JACK.

for this pressure the air is by-passed into the air engine which in turn lifts the ram. In the jack illustrated the ram raises at the rate of 7½ in. per minute, whereas only 2 in. per minute is attainable with a hand power pump.

The jack illustrated has a lifting capacity of 10 tons and a total raise of 103 ins. The ram is telescopic in two lengths, 4 and 5 in. diameter, respectively, and since it is equipped with an air power pump it embodies the latest feature in these tools.

As most railroad men know pit jacks are used for replacing wheels and axles on cars and locomotives. They are placed on a narrow gauge track in a pit below and perpendicular to the main track. The ram raises, catches the axle in a saddle mounted on its end and lowers it clear of the frames, then carries it to an out of the way position at one side of the main tracks. This same type of jack is used for removing and placing heavy motors used on electric railway cars.

Cast Steel Trucks and Brake Beams.

Among the more recent applications of cast steel to railroad rolling stock, it may be stated that two of the most recent devices which have been developed and brought out by the American Steel Foundries are the Vulcan cast steel truck for freight cars, and the Vulcan cast steel brake beam for high speed passenger equipment.

The Vulcan truck, while retaining all of the advantages and well-known features of the Andrews side frame, eliminates the necessity of tie bars, or journal box bolts, and, at the same time, makes it possible to remove a pair of worn

VULCAN CAST STEEL BRAKEBEAM.

wheels quickly and without dismantling the truck.

The Vulcan brake beam is made of an integral steel casting designed to develop the full braking efficiency of the P. C. or L. N. air brake apparatus. It will carry a load of 50,000 pounds with a deflection of not more than 1/16 of an inch, and, what is of more importance, will stand the same test after months or years of service. Unlike a built-up beam, there are no parts to wear or loosen up after the beam goes into service.

THE VULCAN CAST STEEL TRUCK.

To produce these results, the best that is known in foundry equipment is utilized. The furnaces are constructed in accordance with the latest scientific principles for the melting of metals, automatic molding machines reduce the variation and irregularities so noticeable in castings obtained by floor or hand molding, and the finishing machinery is of the newest types, each one designed for the economical and efficient handling of some one operation.

From every heat of steel poured, several castings are subject to the drop and pulling tests in powerful machines, specially designed for the work and that put a greater strain on the castings than could possibly occur in service. The machine used for testing Simplex couplers is the largest ever manufactured, having a capacity of one million pounds. For testing the degree of hardness in the treads of Davis Steel Wheels, or other castings which are subject to rapid wear, the scleroscope is used. This instrument consists of a graduated glass tube, from the top of which a hard steel ball is dropped. This ball hits the metal to be tested and bounds back up against the tube again. It is always dropped from the same height, and with the same force, so that the degree of the re-bound, or bounce, indicates the exact hardness of the steel.

Steel castings of comparatively thin sections cool rapidly on being poured into molds and develop strains caused by the shrinkage of the metal during the cooling process. To relieve these internal strains and establish a fine molecular structure, the castings are reheated, which is known as "annealing." The value of this treatment cannot be over-estimated when the annealing ovens are properly designed to permit all parts of the castings to receive the same amount of heat, and when the proper temperature is used for castings of different chemical compositions.

Seeing His First Submarine.

Speaking once on inventions, Mr. H. G. Wells told of an old fisherman who was out rowing in his boat one day, when a motor canoe sprung a leak near him, and immediately sank. To the indignation of the canoe's occupants, the old man paid no heed to them, but rowed calmly on his way, serenely puffing at his clay pipe. However, the wrecked canoeists managed to swim to him and as they clambered to his boat, one sputtered angrily: "Confound you, why didn't you lend us a hand? Didn't you see we were sinking?" The old fisherman took the pipe out of his mouth and stared in astonishment. "Blest," he said, "if I didn't think ye wuz one o' them new-fangled submarines."

The gentlemen who rush at travelers entering modern stations to take possession of small baggage put high value upon service rendered. Most of them display disgust when they are offered less than a quarter. A New York misanthrope has started a movement to reduce the payment of hand baggage carriers to one nickel—a new one if possible.

Books, Bulletins, Catalogues, Etc.

Practical Locomotive Operating.

This is a notable book by Mr. C. Roberts, assistant road foreman of engines, and Mr. R. M. Smith, air brake instructor, both employed on the Pennsylvania railroad. Both authors are men of wide practical experience in railroad work, and have brought to their task a degree of thoroughness not common in many books from the hands of men engaged in the mechanical department of railways. The book is especially adapted for engineers and firemen. Its particular specialty is the running, firing, and care of locomotives in service. The construction, design and proportion of locomotives are only touched on in a general way. The air brake is hardly dealt with at all, and the authors have, perhaps, acted wisely in this regard, because, as is well known, this special feature is sufficiently important to be dealt with in separate works, which are being constantly revised, and brought up to date. There are nearly one hundred excellent illustrations, and also a variety of very useful notes and tables. The work extends to 281 pages. The presswork and binding are of the best, the latter being in flexible morocco. The book is published by J. B. Lippincott Company, Philadelphia, and sells at two dollars.

Wireless Telegraphy and Telephony.

A third edition of a Manual of Wireless Telegraphy and Telephony, by A. Frederick Cross, is now ready, and on sale by John Wiley & Son, New York. The rapid strides in wireless in recent years have made a revisal of the Manual a necessity. The alternating current transformer has largely taken the place of the induction coil, and the auto receptor has almost superseded the coheror receptor in practical installations, both changes marking important improvements. The book is divided into twelve chapters and the entire apparatus in all its details as well as in action is fully described and illustrated. The letterpress illustrations and binding are all in the usual high style of this well known publishing house. 300 pages, cloth binding. Price, $1.50.

Ashcroft Engineering Specialties.

The Ashcroft Manufacturing Company has just issued a new catalogue describing and illustrating the company's steam, pressure and vacuum gauges, Edson recording gauges, Tabor engine indicators, engineering specialties and pipe tools. The catalogue extends to 128 pages and is profusely illustrated. Among other interesting details is a very full description of the Ashcroft prismatic water gauge. This gauge is fitted with flat glass, which will not blow out under the highest pressures and temperatures or sudden changes. The glass and casing are so designed that the water shows black, while the steam space takes on a silvery appearance. There is no mistaking the water level with this kind of gauge. The self-cleaning gauge cocks are also of particular interest. For full description of these and the company's other fine products send for a copy of catalogue "F" to Manning, Maxwell & Moore, 85 Liberty street, New York.

Gold's Curtain Window Ventilator.

The Gold Car Heating & Lighting Company have placed on the market a clever device which meets a real need in a compact, removable, effective curtain window ventilator. It is arranged like an ordinary window shade, but with the spring roller mounted vertically instead of horizontally. It is simply hooked on at the right of the window and the curtain drawn across and hooked on pegs at the left of the window. When in use it is a plain vertical strip which shoots the air up, inducing a positive circulation of air, but completely avoiding all drafts. When not required it can be removed instantly by allowing the curtain to roll up in the case, or it may be taken off the window and removed altogether. In inducing a current of fresh air without drafts, it is the first perfect window ventilator of its kind. It is readily applicable to every kind of window and is bound to come rapidly into popular favor. Send for descriptive folder to the company's office, 17 Battery place, New York.

Railway Strikes.

The Railway Business Association Bulletin No. 12, is an important document just issued by the association on the subject of "The National Menace of Railway Strikes." It presents in a forceful and brief manner some of the causes that has tended to create business anxiety, and the document is issued in the hope that it may be helpful in crystallizing public sentiment to the end that Congress may be impressed with the fact that the Legislature should create machinery of arbitration, which will guard as effectively as possible against the occurrence of strikes involving interruption to railway operation. Copies of the Bulletin may be had on application to the secretary, Mr. Frank W. Noxen, 2 Rector street, New York.

Some men control their business; others are controlled by it. Some men are more self-sacrificing than others, some are more industrious, but when all is said and done, the only way to get a man to work well is to offer him a good reward.

Positions Open and Wanted

WANTED—Position as Chief Clerk to Superintendent Motive Power and Machinery or Master Mechanic by man 39. Now employed in like capacity on large trunk line. Thirteen years in present position. Good record. Familiar with Government Boiler Inspection requirements. Best of reasons for desiring to make change. Address Chief Clerk, care of RAILWAY AND LOCOMOTIVE ENGINEERING, New York.

NEW YORK REPRESENTATIVE.—An experienced man of wide acquaintance would represent a reliable concern in the Eastern territory. Can handle a New York office in all details including exporting. Address "Representative," care RAILWAY AND LOCOMOTIVE ENGINEERING.

Railway Supply Permanent Exhibit

Notes of the Exhibits and Other Items

Metallic Ties.

Metallic ties are shown in the exhibition building by the Universal Metallic Company, Utah. Experiments for a number of years, especially in Europe, have developed the superiority of metallic ties as compared with wooden ties, and their universal adoption is now generally considered to be a mere question of time.

The Universal metallic tie, on which patents have been issued by the United States government, is free from the faults which characterized many of the earlier European metal ties. It is no experiment. The two Americans who invented this tie have profited by the long years of experience and experiment, and have avoided the mistakes of foreign engineers. The fact that this tie is different is proven by the recent United States patents allowed, inasmuch as many of the earlier European ties have also been patented in the United States. Experiments by different trunk lines of the country in years past with European ties should not be confused with the new Universal metallic tie.

The pulling up of spikes in defective wooden ties, the breaking of ties, the creeping of rails, the ever-troublesome low joints, the rails cutting into the ties, are some of the more common track defects. These defects are eliminated by the Universal metallic tie.

It is now in use on the main lines of the Pennsylvania Railroad, New York Central, Pittsburgh & Lake Erie, the Santa Fe, the Burlington Route, the Northern Pacific and the Great Northern, S. L. & L. A. and Bingham & Garfield.

Repeated experiments have demonstrated that the life of metal ties is from four to five times that of wooden ties. Universal metallic tie is protected from the elements by a non-corroding substance which prevents rust and chemical changes. This treatment adds greatly to the long life of these ties, which will last thirty to thirty-five years. The average life of soft wood ties is four years—hardwood ties seven years.

The Universal metallic tie is adapted to present standards of track equipment. They are made of either iron or steel and both metals, after being treated, are protected from rust. When desired by railway engineers these ties can be manufactured to their special analysis. Blue prints, models and prices will be furnished to railway officials on application.

The Brach Automatic Flagman.

A very interesting exhibit is that of the Brach Automatic Flagmen, manufacturers of arresters and signal specialties, with offices at 143 Liberty street, New York. The Flash lamp signal apparatus operates on primary batteries, using very little current, and can be installed at crossings with existing bell, or bells may be eliminated. Their range of warning, both at day and night, extends from one quarter to over two miles. It gives warning for the full twenty-four hours, and replaces the watchman at crossings that are protected only for a limited time. All moving parts being enclosed it cannot be affected by climatic conditions. Most railway officials realize that the fast automobile, motorcycle and other vehicles need more than the sound of a bell to announce the approach of trains at railway crossings. The increased dangers have led state authorities and engineers of prominence to endorse protection combining a visual as well as audible warning.

The swinging red light effect is produced by the alternate lighting of six stationary lamps, one at a time, the light shifting from one side of the signal to the other and back again. The lamps are located between red lenses, so the light can be seen from both sides of the roadway.

The satisfactory operation of the Brach automatic flagman is fully guaranteed, and those who are interested in the device and who have not the opportunity of witnessing its operation should send to the company's office for a copy of Catalogue No. 2.

Calumet Cattle Guards.

The Calumet cattle guard in its perfected form is on exhibition in the Karpen building, and those who have not had a previous opportunity of examining it immediately endorse its efficacy for the purpose intended. The efficiency is secured by the use of alternate high and low bars, which present an uncertain and unstable footing to animals, which deters them from attempting to cross it. The metal bars always present a sharp edge to the hoof of the animal. Its durability is assured by its construction, all parts being of metal and securely riveted together. No bolts or clamps are used. The manufacturers claim that it costs less to instal than any other cattle guard. It can be taken up to permit track work, and replaced in the least possible time. Dragging rigging, brake-beams, etc., will pass over the Calumet guard, instead of tearing it up, and endangering the train. It has no barbs or sharp points that might injure employees or disable animals. The appearance of cattle guards in the track is a feature that has not received much consideration either at the hands of manufacturers, or of the railroads. At this time, when most roads are giving attention to the appearance of their roadway, we believe the symmetrical lines and general good appearance of the Calumet guard will aid very much in giving a good impression of the roadbed where they are installed.

It is particularly adapted to roads where traffic is heavy and which operate high speed trains.

Fairmont Gasoline Engine.

The Fairmont Machine Company, Fairmont, Minn., exhibit their improved stationary and portable gasoline engines. In point of simplicity it is the perfection of a two-cycle engine. The company have had fifteen years' experience in the construction and repairing of all kinds of gasoline engines. The two-cycle engine has long been recognised as the greatest developer of power for a given weight. Its lightness and tenacity under heavy loads has made the par-excellence of gasoline engines. Its complete freedom from vibration and smooth running qualities has made it the choice of men of experience. It is claimed by many experts that the Fairmont gasoline engine has shown an increase in efficiency never before attained by a two-cycle engine, actually excelling the four-cycle type of the same power on very light loads, thus giving all the advantages found in the four-cycle engine without its complication of parts, and retaining all of the superior points of the two-cycle.

It may be added that the engine completely takes care of itself. The secret of this lies in the wonderfully small number of parts used. It has no cams, no gears, no push rods, no eccentrics, no auxiliary piston, no exhaust valve, no air valve, and no movable part to the ignitor. The action of the governor is positive—instantaneous. Its impulse is transmitted by one simple lever, reducing the possibility of wear and lost motion to practically nothing. There are no oil cups to be kept filled. The lubricating oil is mixed with the gasoline, a feature not practicable with four-cycle engines. This is nothing less than gasoline engine insurance. Just as sure as the engine is run at all it is perfectly lubricated. Oil cups are easily forgotten, but gasoline—never.

The Perfection Heater and Purifier.

The Milwaukee-Reliance Boiler Works, Milwaukee, Wis., exhibit their complete outfit known as the Perfection high and low pressure boiler feed, water heater and purifier, which is already in use in many hundreds of factories, mills and public works and office buildings. It is generally admitted to be in advance of anything ever brought out in its particular line. The reports that have come from the most reliable sources in regard to its efficiency are the best proof of its reliability. It saves more than one half of the boiler cleaning, which is so much dreaded by engineers. No pipe joints have to be broken, and seldom, if ever, any occasion arises to go inside the heater.

It is an underfed filter, which is very much preferable to filtering down from the top with a gravity filter. For as when you filter down through the filtering bed, more or less dirt and impurities go with the water and are carried out into the boiler. But when you filter up through and draw the water from top of filtering bed, the dirt remains in bottom of heater and is blown out through blow-off to sewer.

It is self-cleaning by simply reversing the action of the water. Descriptive catalogues may be had on application.

Concrete Mixer.

The Milwaukee Concrete Mixer & Machinery Company have recently placed on the market what is claimed to be the best machine of its kind. A decided advantage on this new machine is that there are no legs or braces to support the frame. The bucket is charged from the ground, and when ready to move, all that is required is to hoist the loading bucket into discharging position, fasten a chain from the bale to the upright boom, and the machine is ready to move. The enterprising company have always a number of their machines of different sizes ready for delivery, and a very liberal offer is made by them to place one of their mixers at work anywhere for a period of five days during which time it may be thoroughly tested by the intending purchaser. If not fully convinced of its merits the mixer may be returned, all expenses in regard to freight charges being paid by the manufacturers.

Dearborn Chemical Company.

The Dearborn Chemical Company in Canada has been recently organized to carry on the business there. A manufacturing plant of reinforced concrete, shown in the accompanying illustration, is in course of erection at West Toronto. The building, which was designed by Von Holst and Fyfe, architects, Chicago, will be completed about midsummer. The investment that is being made by the Canadian company will exceed one hundred thousand dollars. The active head of the Canadian enterprise as vice-president and general manager is Mr. A. W. Crouch, who has been connected with the Dearborn Chemical Company for fifteen years. The Canadian company will specialize on the analysis and scientific treatment of boiler feed waters, both for steam railroads and stationary steam plants.

Crane Company.

The display made by the Crane Company is always of interest and the management of the Permanent Exhibit is particularly fortunate in having the new Crane building adjacent. The close proximity of this beautiful new headquarters gives the additional advantage of being in close touch with the Crane Company's railway department in charge of the genial and ever popular Mr. Frank Fenn, whose cordial salute is frequently acknowledged by his many friends in the exhibit.

In the display window of the Crane building is a tiny Crane valve which rests upon the flange of another valve, which to call mammoth would be too inadequate—let us term it a Mastodon valve weighing many tons and suitable for a 72-inch connection.

Logging Car and Locomotive Brasses.

The Ajax Metal Company, Philadelphia, has just issued a booklet of over 80 pages, devoted to logging car and locomotive brasses, ingot metals, babbitt metals and castings for the lumber trade. It is the first publication of its kind that we have seen treating almost exclusively for those engaged in logging camps. It will be particularly interesting to those for whom it is specially intended, as it presents detailed descriptions and illustrations of every kind of bearings and bearing metals in use in that particular industry. It is also a hand book of valuable data and information on logs, lumber, track laying, rails, weights of cars and materials, grades and other matters of permanent value to the man occupied in mill and camp.

DEARBORN CHEMICAL COMPANY'S CANADIAN PLANT.

H. J. Boe, Draftsman.

An important feature of the Permanent Railway Exhibit is the space occupied by Mr. H. J. Boe. The many and varied interests assembled in the exhibit find it often a necessity to consult an authority on mechanical layouts or detail as the constantly changing demands of the railroads make frequent modification of equipment necessary.

Mr. Boe is a mechanical draftsman of long experience and one fully qualified to advise and assist in designing, remodeling or connecting devices and equipment.

Accuracy in the initial work on the drawing board is as everyone knows of vital importance; a mistake here may entail no end of trouble in future, while a mechanical drawing which is known to be absolutely accurate from the fact that it came from the hands of one always known to be dependable lends confidence to the entire work from its inception, and when the equipment is installed the satisfactory working and adjustment of its parts is no surprise, but is nevertheless a satisfactory conclusion.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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On the Louisville and Nashville Railroad

Our frontispiece may be taken as an excellent illustration of the rapid growth of the Louisville & Nashville Railroad during the last ten years. The smaller engine, No. 18, hauled the through trains weigh together 90,000 pounds. Their united length is 56 feet.

Engine No. 199 was recently constructed in the company's shops at Louisville, Ky. It is a Pacific type superheater engine hauls twelve passenger coaches and Pullman sleeping cars sixty miles an hour on the level stretches on the main line, and occasionally more when necessary.

COMPARATIVE VIEW OF THE OLD AND NEW LOCOMOTIVES ON THE LOUISVILLE & NASHVILLE R. R.

on the main line for several years, and was sufficiently large for the work. It is still running, and handles a three or four car accommodation train on one of the branch lines. The engine and tender locomotive, and is one of twenty now in course of construction. The length of the engine and tender is 77 feet, the weight of both 354,900 pounds, the engine alone weighing 211,500 pounds. This type of

The contrast between these two types of locomotives and their relative sizes are, as we have already stated, a fair example of the development of the road since the beginning of the present century. At that

time there were in operation about 560 locomotives; at present there are 1,030. Ten years ago the mileage of track in operation was 3,044 miles. There are


MARBLE CREEK BRIDGE, KENTUCKY.

now 4,722 miles, and a constantly widening field of improvement is going on in double tracking, reducing grades and curves, installing automatic block signals, and increasing the equipment so as to promptly and economically handle the fast growing traffic of the South.

The rapid growth of the road is not a matter of surprise to those familiar with the great natural resources of the country through which the road passes. The rich valleys of Kentucky and Tennessee and Alabama must be seen in their luxuriance to be appreciated. Starting at Cincinnati the main branch passes through the cities of Louisville, Nashville, Columbia, Decatur, Birmingham and Montgomery, the Gulf of Mexico is reached at Mobile, Ala., and the road continues along the coast to New Orleans, La.

The Eastern branch connects Cincinnati to Atlanta, Ga., and is the main artery to a network of branches traversing the States of Kentucky, Tennessee and Georgia. An endless chain of flourishing towns have sprung up all along the highway and its branches, and what was not long ago impenetrable jungles are now scenes of beauty and fertility that are not surpassed on the Continent in point of richness in verdure or variety of picturesque grouping of hill and valley and forest and stream.

On the west the railroad touches the Mississippi at three points—St. Louis, Mo.; Memphis, Tenn., and at New Orleans, and has contributed greatly to the opening of the Mississippi valley on the eastern side. Like many other of the leading railroads it has added other lines to the system from time to time. The Henderson Bridge and Railroad Company was conveyed to the Louisville & Nashville in 1906, and those of the Yellow River in 1907. The Louisville & Atlantic Railroad Company was also acquired by the Louisville & Nashville in 1909, and is now operated as part of the system.

In addition to these and other roads acquired and leased there are a number of additional lines under construction and projected. Contracts have been let out for several additional hundreds of miles, and by the end of the present year there will be considerably over 5,000 miles in operation. Some of the work undertaken in these extensions are of a gigantic kind, especially in bridge work, the accompanying illustration showing a portion of Marble Creek Bridge giving some idea of the difficulties to be overcome and the method of meeting them. The Marble Creek bridge is 219 feet from the ties to the water level below, and is the second highest bridge in Kentucky.

The view of the Kentucky river at Old Landing gives some idea of the beauty of that section and shows how carefully the land in the vicinity of the railroad is being cultivated. The view of Bush Creek, Kentucky, shows the character of trestle and bridge work on all of the new lines and additions that are in progress by the company. Perhaps the largest work in the way of bridges on the Louisville & Nashville occurs at what is known as Bay St. Louis, and is a typical bridge over the rivers and bayous in the district between Mobile and New Orleans. This single structure extends to almost three miles.

A word may be added in regard to the efficiency of the mechanical and operating departments. While safety first seems to be a new word on some railroads, it is greatly to the credit of the Louisville & Nashville Railroad Company to state that it seems to be safety all the time on the company's roads. The equipment is in excellent condition, and while to the passing visitor there seems to be less hurry and anxiety than in some other parts of the country, the freedom from ac-


KENTUCKY RIVER FROM OLD LANDING, KENTUCKY.

cidents, the general spirit of contentment, and last, but not least, the accumulating balance of profit as shown in the financial reports are all the best proofs that the best men have been selected to carry on the ever increasing traffic and work of the great railroad.

VIEW AT BRUSH CREEK, KENTUCKY.

Greatest Motive Power Exhibit to Be Installed in Wheeling, West Virginia's Semi-Centennial.

The citizens of West Virginia, in celebrating the fiftieth Birthday of the State, determined to make the event educational and historical, and have gathered data along all lines, covering war, peace, schools, agriculture, manufacturing and transportation. The exhibit arranged in connection with the latter will prove unique and in some ways greater than ever before gathered together.

One entire railroad yard will be given over to this exhibit, and it will deal in motive power alone.

The first epoch will be represented by the horse-drawn car of the days before the locomotive; next will follow the "Peter Cooper," the first locomotive used in the United States. These two epochs will be shown through replicas of the originals; and the famous race between the two will be repeated. It was during this race that Peter Cooper had his thumb crushed, the first American railroad accident. By the way, the horse won the race.

From this point up to the present types of locomotives each epoch will be represented by the actual engine used at that time—the Grasshopper, Camel, etc., and each under steam and moving. Splendid motive power exhibits have been installed at all our great expositions, but it remains for the citizens of the live city of Wheeling, West Virginia, to gather such an exhibit, install in the open air, and have it in actual service.

It is planned to gather together as many as possible of the old-time engineers; all well past the allotted three-score and ten, some of them U. S. Senators and men of wealth and fame, and have them, in jumper and cap, with oil cup and lantern, take command, give the "go ahead" signal, and as they mount the steps and the engine moves ahead, films will be taken of the entire scene.

These films will be stored for historical purposes; as this will be, no doubt, the last gathering of a complete history of railroad motive power represented by the real equipment and under steam. The exhibition will continue during the week beginning June 15, to and including June 21. It may be stated that June 20 is the exact date of the fiftieth birthday of the State. There is every indication of a large and enthusiastic celebration.

Long Crossovers.

No less than seventy-eight crossovers on the New York, New Haven & Hartford Railroad are being reconstructed with No. 20 frogs, to comply with the recommendations of the Interstate Commerce Commission and the Public Utilities Commission of Connecticut. This covers all crossovers where high speed trains are run. In addition, twelve important turnouts are to be lengthened in the same way. Included in the total of 168 frogs recently placed are forty-three No. 15's installed as satisfying all demands of safety. In announcing this work, President Mellen, of the New Haven, mentions certain points that deserve careful consideration. Unquestionably a No. 15 turnout can be safely negotiated at a higher safe speed than a No. 10. Whether much higher speed, however, can safely be used over a No. 20 than over a No. 15, or over the No. 16 adopted by the American Railway Engineering Association, is less certain. The sharpest practicable switch point is reached with the No. 15, and with any frog of higher number the same switch points are used, with the same resultant angle, which may, so far as safety is concerned, become the governing feature. Another point brought out by Mr. Mellen seems worthy of consideration. In a short turnout the frog is relatively obtuse and the jump across the flangeway short, but with the longer turnout, the frog angle being much sharper and the gap much longer, the impact is more likely to break the frog point; furthermore, if the guard rails or car wheels are not quite true there is a greater chance with the longer than with the shorter frog of wheels which are proceeding at full speed on the straight track splitting the frog and taking the wrong flangeway. The popular idea that the longest crossovers are a perfect safeguard against accident at any speed overlooks not only this possibility of derailment on straight track with signals at clear, but also the inevitable angle and swing at the switch point, and the impossibility of superelevating the outer rail of the turnout curve. There will always be a safe-speed limit for any crossover or turnout, and it is by no means certain that the same engineman who was always careful to slow down for short crossovers will not meet disaster taking long ones at high speed. With the longest crossovers the American speed mania must still be reckoned with. Orders from railroad officials to enginemen to keep within safe-speed limits are neutralized by the insistent demands that trains must be on time. This may be largely habit or pride on the part of the officials, but back of it all is the same clamorous demand on the part of the public. Their trains must always be on time in spite of storms, fog, frozen interlocking, stalled freight trains, derailed switch engines, slow orders around construction work, hot boxes, bad coal, engine failures and a hundred other vicissitudes that may beset a long-distance passenger train. This means that lost time must be made up, even at considerable risk, and until the public elects to put safety ahead even of speed there will be occasional disasters on the longest of crossovers.

New Locomotives for the Lake Shore & Michigan Southern

It will have been observed that the freight traffic of the Lake Shore & Michigan Southern Railway has formerly been handled by Consolidation type locomotives. The steaming capacity of the Consolidation type locomotive is necessarily limited, since the entire boiler and firebox must be carried over the drivers. These boiler limitations are now becoming serious and the Lake Shore officials, after careful consideration, placed an order with the American Locomotive Company for the twenty Mikado type locomotives herewith illustrated.

These locomotives have been placed in service on the Toledo, Eastern and Franklin divisions. Three runs were made between Coalburg and Carson, a distance of 47 miles. The superheater consolidation engines have been handling an average load of 4,250 tons. The new Mikados have been handling loads as high as 6,680 tons on the average or more than 50 per cent. heavier loads than the engines they have superseded, and at a slight excess in speed. These runs were made on the Franklin division, in order to determine just what the maximum tonnage was that the engines could handle, and do not represent the average tonnage hauls of these engines.

As these Mikado engines have only been in service a short time, the officials have not been able to make any comparison as to water consumption. A record of the coal consumed has been taken for several different classes of engines on the Eastern and Michigan divisions, and the following are exact averages of the different classes of engines in regard to this important particular. Locomotives of the 2-6-2 type weighing 245,000 pounds hauling 42 cars with a train tonnage of 1,312 tons have consumed 10.6 tons per trip, being 12.28 miles per ton of coal consumed. On the consolidation or 2-8-0 class, the engines weighing 180,000 pounds hauling 41 cars, with a train tonnage of 1,585 tons, the consumption of coal has been 13.1 tons per trip, or 9.93 miles per ton of coal. In the same type of engine weighing 240,000 pounds, with 65 cars of a train tonnage of 1,691 tons, 15.4 tons of coal were consumed per trip, being an average of 8.44 miles per ton of coal.

Coming to the new Mikado, superheated engines weighing 322,000 lbs., with 70 cars of a train tonnage 3,203 tons, the consumption of coal per trip has been 12.85 tons, being an average of 10.1 miles per ton of coal. It should be added that while these figures speak loudly in favor of the Mikado engines, the figures have probably been favorably affected by the cars in the train being loaded more heavily. In any event they show the large reductions which will be obtained in operating costs. Their marked success proves that it is possible to secure enormous power at a largely reduced cost.

In regard to the chief features of these powerful locomotives. The boiler was given special attention, and the builder's latest knowledge of boiler proportions was applied. It is 86 inches in diameter outside at the first course and 89⅜ inches in diameter outside at the largest course. The barrel is fitted with 295 tubes, 2 inches in diameter and 21 feet long. A 43 unit, Schmidt type, top header superheater was also applied. The firebox is 114⅛ ins. long by 75¼ ins. wide, and combines a firebrick arch and the railroad company's standard arrangement of combustion tubes. The good steaming qualities of this boiler equipped with superheater, firebrick arch and combustion tubes, should be materially increased by the pneumatic firedoor applied, the latter holding the influx of cold air to the firebox down to the minimum.

It may be added that the leading railway men on the railroad have expressed themselves as being greatly satisfied with the excellent performances of these locomotives, and the superiority of the Mikado type of locomotive is universally admitted by the engineers who have had an opportunity of handling them.

The following are the general dimensions:

Weight on driving wheels, 245,000 lbs.; weight on leading truck, 27,500 lbs.; weight on trailing truck, 49,500 lbs.; weight, total of engine, 322,000 lbs.; weight of tender, 155,800 lbs.

Wheel base.—Driving, 16 ft. 6 ins.; wheel base, total of engine, 36 ft. 1 in.; wheel base, total of engine and tender, 68 ft. 10½ ins.

Cylinders.—Diameter and stroke.—27 x 30 ins.

Valves.—Type, piston; valve gear, Walschaert.

Wheels.—Diameter of driving, 63 ins.; wheels, diameter of truck, 33 ins.; wheels, diameter of trailing, 45 ins.; wheels, diameter of tender, 36 ins.

Journals.—Driving main, 11½ x 22 ins.; journals, driving others, 11 x 12 ins.; journals, truck, 6 x 12 ins.; journals, trailing, 8 x 14 ins.; journals, tender, 5½ x 10 ins.

Boiler.—Type, straight top; boiler pressure, 190 lbs.

Tubes.—Number and diameter, 295, 2 ins.; flues, number and diameter, 43, 5⅜ ins.; tubes, length, 21 ft.

Heating surface.—Tubes, 4,494 sq. ft.; heating surface, firebox, 218 ft.; heating surface, arch tubes, 28 sq. ft.; heating surface, total, 4,740 sq. ft.; superheating surface, 1,084 sq. ft.

Water.—Capacity of tender, 7,500 gals.

Coal.—Capacity of tender, 12 tons.

Length over all, engine and tender, 78 ft. 5 ins.

Extreme width, 10 ft. 2½ ins.; extreme height, 14 ft. 11½ ins.

Tractive power.—Maximum, 56,100 lbs.

MIKADO TYPE OF LOCOMOTIVE FOR THE LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.
D. R. MacBain, Supt. of Motive Power. American Locomotive Company, Builders.

General Correspondence

Derailment.

Editor:

Referring to page 125, of the April issue of Railway and Locomotive Engineering, Mr. Nihoof has a short article on the subject of derailment, and quotes an instance of a consolidation locomotive mounting the rail when running backwards, and states that he discovered the cause and applied the remedy. While it would be interesting to know the exact details of the cause of the trouble in the particular instance to which he referred, I might state that it is no uncommon trouble not only in the consolidation class but in other kinds of locomotives that are not equipped with what may be called adjustable trucks both in front and back of the engines, that when they have undergone repairs they will be found to wear their tires excessively on one side and occasionally mount the rails and jump the track, especially at curves.

The trouble is not far to seek. There is some error in the alignment of the parts somewhere, or there is a weakness in the springs in some part. In regard to the alignment this matter, of course, embraces not only the thickness of the flanges of the driving boxes, the thickness of the overlapping sides of the wedges, but also the exact relation of the wheel centres to the wheel rims. In regard to the springs it is a well-known fact that even the best springs are apt to show some little variation in their degrees of resiliency, and a low corner on a locomotive affects very materially the straight running of the locomotive, the tendency to what is known as "nosing" being very great in the low side of the engine. Hence when an engine, after being repaired and having been in service for a short time, it is worth while carefully examining the locomotive on a perfectly level piece of track, and it is rare indeed if it be found to be exactly level in every way as it should be to meet the emergencies of the severe service of the present day.

In a matter of this kind there is little or no time for a thorough examination, and any defect soon leads from bad to worse, the organic defect magnifying itself until some disaster or breakage occurs. Even the adjustment of the rods, especially the main rod, which, instead of being carefully fitted at both ends to its proper alignment, is very frequently stuck on in the blind belief that it will adjust itself in a few days, whereas, unless the thrust is exactly straight, it has a pernicious effect on every part of the great machine.

These remarks are, of course, of a general kind, and, as I already stated, it would be interesting to hear from your correspondent the exact discoveries that he made in regard to the trouble of which he complained. J. MacLay.

Philadelphia, Pa.

Walschaerts Valve Gear.

Editor:

The Walschaerts gear is always spoken of as having constant lead. This is not altogether true, for although the lead is constant at dead center, if the crank be backed off center a little (see figure) hooking up the lever from forward position will open the valve more (the gear being drawn for inside admission) and hence increase the lead or preadmission. The same, of course, is true at either end of the stroke in forward or backward gear.

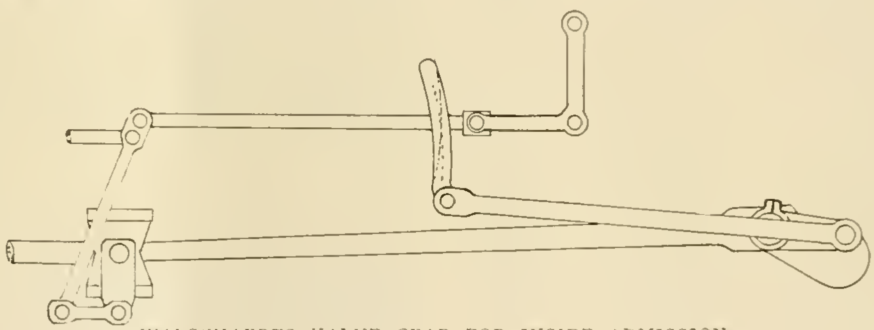
Many probably think that the so-called constant lead is an advantage. The gear would be inferior if this were the case, because when a valve in motion is designed for a certain lead in full gear, that lead is supposed to admit just enough steam to relieve the crank pin on passing centers of stopping the main rod, piston rod, piston, etc., when the engine is traveling at slow speed. When, however, the engine is traveling at high speed, the force of the main rod and attachments is much greater and there is less time for steam to fill the clearance space; therefore, to receive the same results as at low speed, steam must be admitted earlier; this is the case when the lever is hooked up.

I am not making one of the old mistakes in saying that lead makes a smoother running engine by helping to stop the main rod, etc. In whatever way the main rod is stopped the jar has got to come on the engine at one point or another, and by having it come on the cylinder heads through the medium of cushioned steam, strain is taken off the crank pin.

Increasing preadmission as the lever is hooked up is also a feature of most other radial gears.

William J. Langdon.

New York, N. Y.



WALSCHAERTS VALVE GEAR FOR INSIDE ADMISSION.

Freight Trains Parting on the Road.

Editor:

At a recent staff meeting of the mechanical officials of the Erie Railroad, Mr. Wm. Owens, of the New York Air Brake, spoke about freight trains parting. On this subject he remarked: While there may be some causes chargeable to inefficient operation by the engineer, I believe our greatest trouble can be charged to unequal braking forces on cars, that is, cars breaking at different percentages on the different roads, which I believe could be regulated or adjusted by the American Railway Association, or the different mechanical departments of the railroads. While some roads are adhering to the old standard practice of braking the cars at 70 per cent. of the light weight of car, based on a 60-lb. cylinder pressure, others are going as high as 80 per cent., and some as high as 75 per cent., based on a 50-lb. cylinder pressure, while the air brake companies recommend 60 per cent. based on a 50-lb. cylinder pressure, it can readily be seen that the above conditions cannot help, but lead to bad results, especially when there are a number of these high brake cars located together in the train, especially when empty. If they are located in the rear of the train, they have a pulling effect, and a buckling effect when located ahead or in the forward portion of the train. There are also a great number of cars having ineffective brakes, either due to bad design or being in bad condition, which add to the trouble.

The question of building up trains is

another important factor, although may be somewhat expensive to follow in congested yards, as several tests have shown that, if the loads and empties are mixed alternately throughout the train, a decided improvement can be looked for from an operative standpoint. While some roads advocate putting a few empty cars in the forward portion of the train, this may be an open question, as it has always been the practice to locate all loads ahead, but where consistent, it is always better to run the loads and empties separate. There are a great many cases of trains parting, which can be charged to rough handling in yards, which seems rather hard to control, especially in what is called "hump yards," as a great many draft riggings are ruptured in yards, which do not give out until they are in transit on the road, which the train crew should not be held responsible for.

The question of overloading engines is another factor causing more or less trouble in breaking trains in two. While the writer believes in giving the engine all that can be hauled running at a reasonable speed, it still remains a question of determining the most economical load to give the locomotive, as when the engine is loaded so heavy, and becomes necessary to take the slack at water tanks, and hard places, it cannot help but being injurious to the draft gears, although they may not give out at the time of starting, or taking slack, but will give out at the most critical time, or when least expected. While the engineer has no control on the way the slack is running, or in other words, the differential braking force, he can be governed to a very great extent on how to make the brake pipe reductions in order to absorb the shock, especially after making the first stop, which will indicate the way the slack is running.

Hoping the above may be of some value to you, that is, if you care to publish the same, which will be nothing new to the air brake world, but hope it will have some effect on bringing about uniform standard of braking cars throughout this country, which in my opinion will not only save money, in the cost of repairs, but will save delays, and no end of annoyance to the men who are responsible for the operation.

Buffalo, N. Y. W. E. Thomson.

Philadelphia & Reading Locomotives.

Editor:

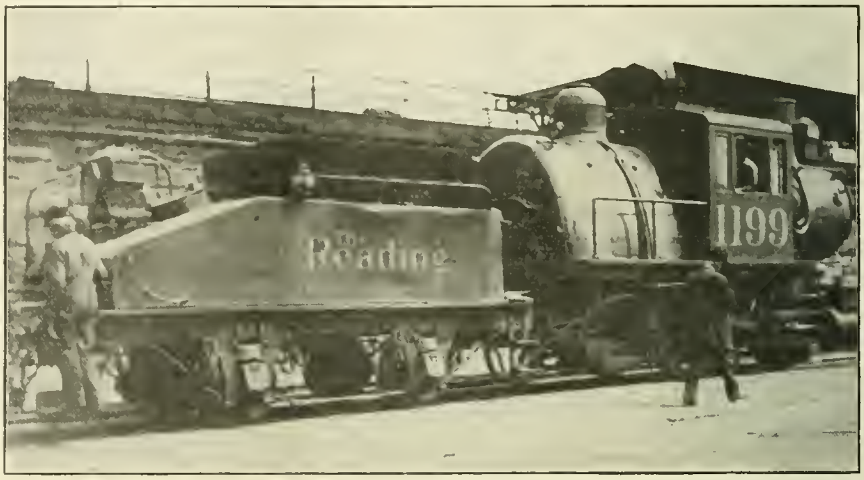
To engineers away from the anthracite coal roads the accompanying photographs may prove of interest, while to the engineers of the Reading they will be an old story.

The pictures were all taken in the yards of the Philadelphia and Reading Railroad at Wilmington, Del. Nearly all the locomotives of the P. and R. have the Wootten firebox (named after its inventor, J. E. Wootten, once general manager of the road), and the cab over the front part of the boiler. This does not look so strange on a rather long engine, like an "Atlantic" type or consolidation, but it gives an 8-wheeler or a 4-coupled switcher a very queer appearance. The Reading has a great many industrial sidings with short curves in the streets of Wilmington, and engines like "1199" do the shifting work on these tracks. In winter the absolutely unprotected fire deck must be an uncomfortable place, particularly if it is snowing or raining, but of course this isn't so important on a switcher. The engines are very powerful as the big firebox keeps them good and hot. The four-wheel tender will also look odd to some readers I expect, but these are still used in New England to some extent and shorten the total wheelbase a good deal.

"1231" is a little Baldwin saddle-tank, used for about the same service as "1199."

To anyone interested in odd types of engines the eastern hard coal roads are regular museums as many peculiar kinds of locomotives have been developed for special service. Hugh G. Boutell.

Washington, D. C.



LOCOMOTIVE NO. 1199, PHILADELPHIA & READING RAILROAD.

LOCOMOTIVE NO. 1231, PHILADELPHIA & READING RAILROAD.

Shocks on Passenger Trains.

Editor:

Occasionally, when riding in the rear portion of long passenger trains, one is treated to a severe shock, especially at water stations, due to the slack running up. This is very disagreeable to persons sitting up in day coaches, but is much more so to those who have paid their fare in sleeping cars and expect to get a night's rest. To be moved lengthwise in a berth until the head strikes the end of same, is not a pleasant sensation and one that has never yet been seen advertised in any of the many timetables examined.

The writer of this article does not believe that any engineer handling a passenger train would purposely discommode the patrons of the road by which he was employed, and it is well known that in most cases he is not aware of a shock at the rear end, as the powerful brakes on the engine and front cars prevent any movement by which it could be known.

Due regard for a few simple rules and instructions that have been given almost as long as air brakes have been used, will overcome such trouble and prevent

the hurling of unprintable epithets at the engineer.

There is no doubt but that the use of two applications, as generally recommended, is the correct method of making stops, especially those at water stations, or where close work is necessary and wherever possible the first application should slow the speed of the train to twelve or fourteen miles per hour, and the stop then completed with the second and a light application, that if held applied until the stop is made, will not cause a disagreeable shock.

When releasing the first application care should be used not to hold the brake valve handle too long in release position, to avoid overcharging, not only the brake pipe above the auxiliary revervoirs, but the auxiliary reservoirs on cars at the front end over those at the rear. Inasmuch as the brakes respond when the brake pipe pressure is reduced to less than that in the auxiliary reservoirs, it stands to reason that those brakes on the cars at the front end of the train, if charged higher than those at the rear, will apply sooner and no doubt will be powerful enough to stop the head end before the brakes have time to apply at the rear with a consequent bump, due to the heavy rear cars running up.

In all cases where a second application is to be used directly after the release of the first, the brake valve handle should be allowed to remain in release position only just long enough to insure moving all triple valves to release position, and then should be placed on lap position, and even with the Westinghouse ET and the New York LT equipment, with which instructions are given to remain a few seconds on running position to permit some of the engine brake cylinder pressure to escape, care should be used or overcharging will occur. Prevent as far as possible main reservoir pressure going to the brake pipe more than is necessary to move the triple pistons to release position. By so doing, the pressure that was necessary to put into the brake pipe to release the first application, will in a few seconds equalize throughout the train, and when the first reduction for the second application is made all brakes will apply and the cars at the rear will not run up so forcibly, if at all.

The over anxiety on the part of some engineers to spot the manhole under the water crane frequently leads to the movement of the brake valve handle over the service notch onto the emergency, and although an emergency application may not be obtained, a quick service will be, and in the event of the overcharged front end, the shock is very much aggravated. Unless at points where it is impossible to back the train, due to the grade, it is much better practice to run by the water crane and then to crowd the train back the desired amount. X. Y. Z.

Misplaced Tank.

EDITOR:

In a certain roundhouse the locomotive fitter put up an air tank with a special type of brackets shown in the accompanying drawing. When the job was done it was found that the tank was three inches too high. After discovering his mistake, he had the good sense not to cry his eyes out about it, but before the foreman came around he discovered the error into which

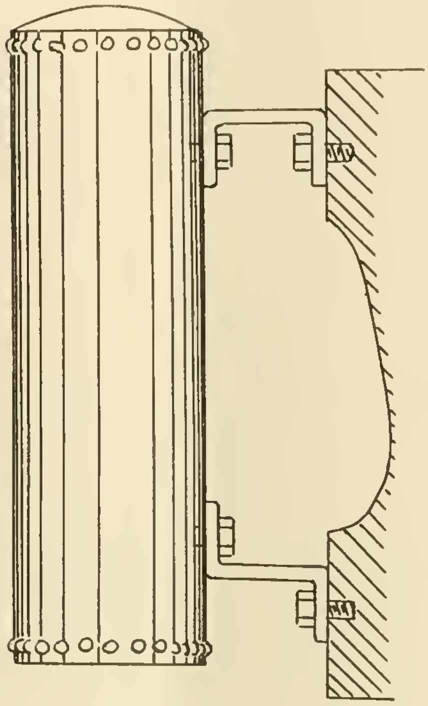


FIG. A.

he had fallen and succeeded in rectifying the mistake.

Fig. A shows the tank in position when it was too high, and when the situation, like a dark cloud, fell upon the misguided machinist, and if any of your readers will kindly obscure Fig. B, and try and work out the remedy, he will get a real lesson in ingenuity. If, however, he fails to see where the remedy can be applied without drilling and tapping new holes in the tank, Fig. B will show the method in the particular instance whereby a rectification was made and the tank lowered to the proper position.

The brackets might not always come like those in the illustrations, but they may always be made to come right without making too many holes in the tank.

Montreal, Canada. J. G. KOPPELL.

Loose Axles.

EDITOR:

During my travels and in conversation with those directly interested in running repairs and the failures incidental thereto, I found some anxiety in regard to wheels under tenders and cars becoming loose on axles. At first glance the apparent cause would be improper fitting and pressed on at too low a pressure. But when records show that wheels were pressed on at from 50 to 70 tons, according to bore and length of wheel seat, and that wheels had been running for a considerable time before becoming loose, I am led to believe there is a latent cause for same. I fail to see that heating caused by brake action on circumference of wheel would be responsible for failure, but I can see where a very hot journal would cause axle to expand and change conditions in wheel fit. As this is a very serious question, I would be pleased to have the opinions of any who may have had similar experiences.

Pittsburgh, Pa. WILLIAM SCOTT.

Consolidation of New York Central and Lake Shore.

It is currently reported that the New York Central Railroad Company is about to be consolidated with the Lake Shore & Michigan Southern Railway Company. That move has been foreseen for several

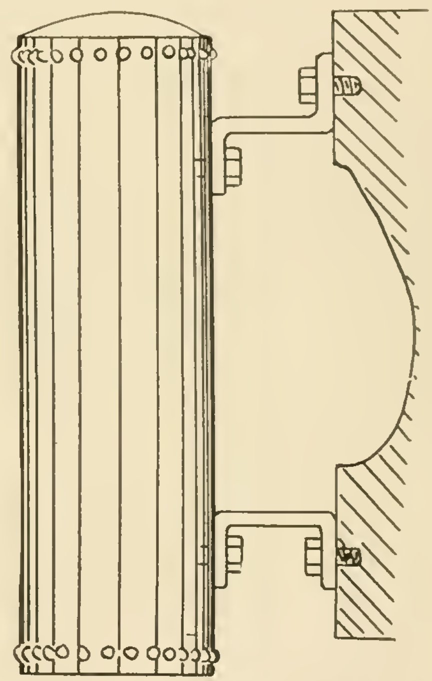


FIG. B.

years and will bring about very little change in the way the properties are operated. It is understood that there will be little change in the management and that the present officials will hold their positions.

Old Time Railroad Reminiscences.

BY S. J. KIDDER.

In the early seventies the air brakes had not at this time come into use on the New York Central, hand brakes being used to control the trains, though a power brake for emergency purposes had been applied to the passenger car equipment.

This brake, known as the "Creamer," consisted of a large spiral spring attached

to the hand brake staff at the end of the car and which was wound up ready for action by rotating the brake wheel in a direction opposite to that when applying the brake by hand. Attached to the mechanism was a cord extending upward to the car roof thence through the train to the engine cab, the arrangement being such that when the engineer pulled the cord the coiled springs on each car were released; the expanding springs then causing the brake staffs to rotate and wind up the chains leading to the foundation brake gear, thereby at once setting all the brakes of the train. A release of the brakes was effected in the same way as when applied by hand, after which the coiled springs were again put in tension.

Freight trains were made up of thirty to forty cars and a bell cord extended along the top of the train from a reel on the roof of the way-car to the signal bell in the engineer's cab. This bell rope, about the size of a clothes line, was one of the greatest nuisances the train men had to contend with and as a means of communication between the rear and front ends of the train was practically useless.

The yardmaster despatched all trains from terminals, by a wave of the hand and it was often problematical to the engineer whether or not the conductor and rear brakeman were aboard. The handling of traffic through the city of Rochester was decidedly hazardous, particularly when westward bound. The tracks, then not elevated, were on a level with street crossings extending through a thickly settled business and residence district, with down-grades approaching the passenger station from either direction and all freight trains passed directly through the big train shed.

In order to climb the steep, crooked approach to the Erie canal freight trains were compelled to pass through the station and across the streets at a speed not conducive to safety and frequently as many as five trains were coupled together and in that condition crossed the city. Unlike railroads in the West no fixed limit of speed governed the movement of freight trains and as the last half of the division going in either direction was down-grade the speed attained would in no wise suffer in comparison to that made by fast merchandise or stock air brake trains of the present day. The freight yards in East Buffalo had several long tracks and to avoid blocking incoming engines between trains of cars, flying switches were frequently made, the engine cutting off perhaps a half-mile from the yard and by facilitating its movement down the main line passed over the switch which was then opened to head the train into the side track where the brakeman brought it to a standstill.

Among the safety appliances along the road was an arrangement at each station by which trainmen were advised at what time the preceding train had passed.

Above the telegraph office window of the depot and projecting outward over the platform was a triangular shaped frame with glass sides so arranged as to be illuminated at night. Inside the glass the passing time of each train was registered in large numerals, thus indicating to engine and trainmen the number of minutes the train ahead had passed the station. Certain unwritten rules, too, were rigorously followed by every one interested. If two trains, west and eastbound for instance, met within a mile or two of an obscure curve, the westbound train having just rounded the curve, the engineer of this train gave two short blasts of the whistle which indicated that the eastbound track was clear, but if a train had been met on the curve no signal was given which would be understood by the eastbound train to imply that the train it was following had not cleared the curve when met by the train moving westward. All country road crossings were provided with flagmen and these men did their part, when a train passed, by holding up as many fingers as minutes intervened between two trains moving in the same direction, providing they moved within a few minutes of each other. These somewhat crude precautionary measures may not have been based on the scientific methods of modern automatic signals, but that they were an effective means of contributing to both making time and safety was very frequently proven. My most unique experience while on the New York Central occurred one evening in Buffalo when I was fairly forced to join a theater party. The roundhouse was located near the Exchange street passenger station and the trainmen usually rode down-town to the roundhouse in the vicinity of which were numerous places where good meals were obtainable. About five o'clock in the evening three sections of a train had arrived at Buffalo, my engine being on the second one. Reaching the roundhouse the engines were promptly marked out at 8 o'clock for a return trip, mine, as on the recent arrival, being the second of the trio. Along about supper time the three engineers, conductors and a number of the firemen and brakemen repaired to the Continental Hotel and while seated at the table one of the conductors suggested that as George Fox with his play "Humpty Dumpty" was holding forth at a theater near the Terrace, why not take in the show?

To my surprise the proposal met with general endorsement and when I ventured to protest with the remark "that we were all marked out at 8 o'clock" it was answered with a cry of derision and the emphatic statement, "We are going to the show." We did go and toward the hour of midnight meandered down to the roundhouse, got out our engines and proceeded to East Buffalo for our trains. No questions were asked either at the roundhouse or yard as to the cause of our delay and as we pulled out of the yard the incident was a closed one. Engine and train men preferred the Buffalo rather than the Rochester-Niagara Falls division as the latter, with the exception of a few miles, was single track. Trains going east had the right of way and as no telegraph train despatching was practiced the westbound trains could get the main track only when no train from the opposite direction was due.

As a consequence delays were common and not infrequently lengthy. Way freights were in a class all by themselves, having no running rights over passengers or freight trains in either direction and the writer observed instances where this local train took the side track before sunset and was still there when old "Sol" showed up the following morning, still waiting for an opening to proceed to the station, perhaps only one or two miles beyond.

My stay on the New York Central was a comparatively brief one, the result of ominous clouds appearing and of a character to indicate that my services would not much longer be required. I had hardly become well settled in my new job when the panic of 1873 came on and as it progressed rumors began floating about that a curtailing of expenses would soon result and as I was one of the last to enter the service would logically be among the first to go. As such times, of all others, are not good ones to be out of work, I wrote my old master mechanic in the west that railroading in the east had no charms for me and if he had anything for me to do I would like to come back, and to which he promptly replied "plenty of work, come as soon as you please." Following the receipt of that letter it did not take hours, but minutes only, for me to reach the office, quit and get a bill of my time, and on the first train westward I took passage for Iowa. Two days later, with an elastic step I entered the master mechanic's office in Austin where, following a good natured chafing by that official for getting homesick so soon he arose from his chair, pointing at the roundhouse as he did so, and remarked, "your engine is over there ready for business and you can go out on your old run tonight."

Dinner of Erie Railroad Association.

There is connected with the Erie Railroad a social, friendly organization formed mostly from officials of the road who meet occasionally round the social board for the promotion of friendly intercourse. The annual gathering of this Erie Railroad Association, which took the form of a dinner, was held in Buffalo, N. Y., on the evening of May 2. In the absence of President Underwood Vice-President

J. C. Stuart opened the proceedings by introducing Mr. George N. Orcutt, who was chairman. In a few well-chosen remarks he introduced Mr. George A. Post, who performed the duties of toastmaster. Mr. Post is a graduate of the Erie, his father having been one of the old-time conductors while George himself reached the position of chief clerk of the motive power department at Susquehanna before he left railroading to become a Congressman. This experience enabled Mr. Post to open the social functions with a most arousing speech.

The speeches of the evening partook mostly of humorous personifications. Mr. E. E. Clark figured as chairman of the Interstate Commerce Commission and gave the cheering news that his board intended to adopt a new policy and permit the railroad companies to manage their own business as other companies do. The other speakers were Mr. Clyde Colby, Judge Moore, and Dr. Angus Sinclair.

A most attractive part of the gathering was the singing of Mr. H. C. Hooker, secretary to President Underwood, and a glee party that he had got together, mostly Erie boys.

The Erie employees are noted for mutual friendliness and high esprit de corps. We believe that the association whose social doings we have recorded, does much to promote the spirit of good fellowship for which these employees are celebrated. It is pleasant to know that these annual reunions have become an established feature in the life of the Erie employees, and beyond question they do much to establish a kindly feeling among the men who have to shoulder the greatest portion of the responsibility of the successful management of the road, and which has shown such a marked degree of progress under the kindly discipline of the accomplished and gentlemanly president, Mr. Underwood, and we trust that other roads may emulate the worthy example of the leading spirits of the Erie.

Kindly Words from President Underwood of the Erie.

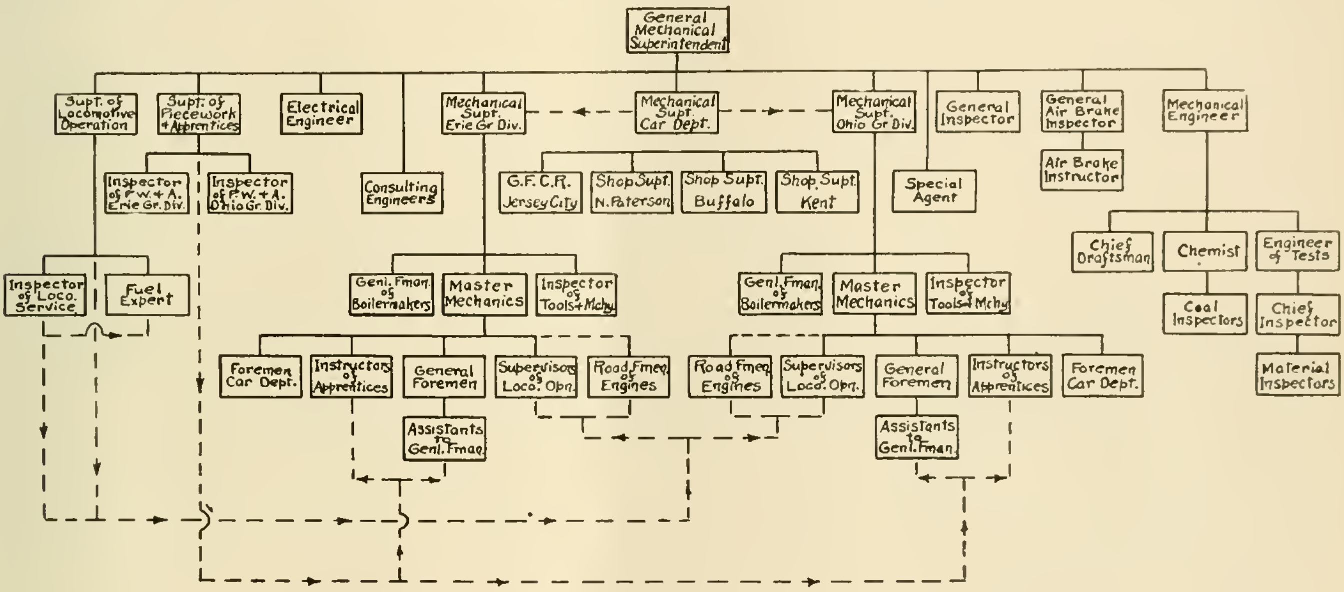
President Underwood, of the Erie Railroad, who is noted for his kindly courtesy toward all classes of his subordinates, was unable to attend a social dinner of Erie men, so he sent a hearty greeting as follows:

I send this my hearty greeting and regret that I am unable to meet with you this evening. I can only look forward to that pleasure on some future occasion. It has been stated before that the success of a railroad depends on its units, and every man is a unit. There is no employment on a railroad that is not important, that is not worth doing well, just as there is no unimportant part of the machine, no angle, no joint or bolt which has not its definite purpose, or which must not render a good account of itself in the finished purpose, or which must not render a good account of itself in the finished product. The Erie company wants more from its employees than the mere work they are appointed to do, just as the employees need more from the company than their money at pay day.

If the company does not give its men more than their money, if it does not take a human interest in them beyond its business relations with them, it will always fail to get the results out of the pay roll to which it is entitled. If the interest of the men in the company does not go beyond the mere doing of their work, they cannot get out of their employment all that is coming to them. The future officers of the company are somewhere down the line doing the work that is the only practical preparatory for advancement.

Railroad men are not made in the schools. The more education, the better, of course, but experience is the finish that makes for success. When every employe of this company feels the personal responsibility of his employment, when every employee regards the public as the potential friend of the company, and its great customer; when every employe regards his work as a means to his own success and takes the interest in his work that brings to it the pleasure of doing it, nothing can prevent the success of both company and men. There can be no separation of interests.

It must be a common interest in each other, or no lasting or permanent success is possible. I congratulate you who are assembled in that you are free agents not dominated by any oath-bound labor organization; that as American citizens you are free to work when and where you please. It is from the ranks of such as you that the officers of railroads must be recruited. I give you the toast, "A happy evening full of good cheer and pleasure."



ORGANIZATION OF THE MECHANICAL DEPARTMENT OF THE ERIE RAILROAD.

San Francisco Inviting Conventions of 1915.

Through the courtesy of Mr. H. J. Small, general superintendent motive power of the Southern Pacific Company, Mr. James A. Barr, manager Bureau of Conventions & Societies, Panama Pacific International Exposition, is requesting the members of the Master Car Builders & Railway Master Mechanics Associations to hold their annual conventions in San Francisco in 1915. It is rather early to take action in a movement of that character, but it is not too early to begin working up sentiment in its favor. It is a mighty long call from Maine to California, and a long weary journey from Portland, Me., to San Francisco, Cal., but the widening of experience due to the ordeal is well worthy of the labor and fatigue undergone.

General Foremen's Department

Annual Convention of the International General Foremen's Association.

Mr. Wm. Hall, secretary-treasurer of the International General Foremen's Association, has issued a special circular to the members in regard to the condition of the association and presenting interesting details in regard to the forthcoming convention. The association has been in existence for nine years, and is growing in importance to the railroad world more and more as the years go by.

The object of the association is, the improvement of its members by exchanging ideas, by means of annual meetings, and the reading and discussion of papers along the lines pertaining to railway locomotive shop practice, thereby making themselves of greater value to the companies employing them and for whose interest they labor. It also has a tendency to place its members in a position where they may qualify themselves for advancement, and for greater responsibilities.

The Master Mechanics' Association has realized the importance of the General Foremen's Association and have asked that they take up and consider papers along lines that the master mechanics have not the time to take care of.

This year's convention of the association, which will be held in Chicago, July 15 to 18, inclusive, will be of particular interest to the mechanical world, due to the importance of the subjects selected for discussion at this convention.

Subject, No. 1.—Maintenance of Superheated Locomotives, by Mr. P. C. Link, of the C. & E. I. Ry., will be given thoughtful consideration due to the general adoption of the superheated locomotive on our railroads. Some roads are experiencing trouble in their maintenance, and the discussion following the reading of the paper will bring out the different methods best suited in overcoming any existing defects.

Subject, No. 2.—Engine house efficiency is the title of subject No. 2, by Mr. W. Smith. Engine house efficiency is always a live subject and this paper will bring out up to date methods in handling power which will be of material assistance in increasing locomotive mileage.

Subject, No. 3.—By Mr. L. A. North, of the I. C. Ry., entitled "Shop Shedules," is a new subject for a mechanical association to discuss, but it is important in this day and age. Mr. North is particularly suited to handle this subject; his experience along these lines is unquestioned. He will receive very able assistance from Mr. Henry Gardener, supervisor of apprentices of the New York Central Lines. They will show how a shop output can be restricted by unwise shop schedules.

Subject, No. 4.—Driving Box Work, by Mr. Geo. H. Logan, of the C. & N. W. Ry., will provide and develop methods which will prolong the life of the modern locomotive as a serviceable revenue earning machine and this convention will prove to its membership that too little attention has been paid in the past to this most important factor of the locomotive.

In addition to the subjects outlined there will be many interesting side subjects of great interest which will be handled by the members of the association generally. Papers will be presented by several of the leading mechanical and operating officials of the country, touching on the various subjects of interest to the members of the convention.

Through the courtesy of the officials of the Chicago & North Western railway Co., a special train will be furnished to take as many of the members and others attending the convention, as wish to visit their very extensive shops at Forty-second avenue. All that possibly can should avail themselves of this fine opportunity to see up to date work and methods in an old time shop.

Main Rod Brasses.

The reducing or refitting of main rod brasses is of vital importance in locomotive running repairs and a few simple directions in regard to the subject will be of interest. To begin at the beginning, before disturbing any nuts or bolts or adjusting wedges, take particular notice where they are and mark the wedge how high or how low it stands in comparison with the brasses and rod; take a bar and pry the rod, at the same time noting if brasses fit the rod tight. This done, we are now in a position to know something of what is required. The second proceeding is to block the rod and take down our brasses. No rule can be set as to method, as all rods are not the same, but one rule must be observed, and that is, to place all nuts and keys in such a position that there be no mistake in replacing them. If there is any likelihood of some other person having to put the job back, all parts should be marked. Half the battle is knowing the conditions and places of the various parts.

Having the brasses down and cleaned off, we can proceed. First, get the size of the pin with a pair of outside callipers and take the size from them to an inside pair. Before taking any metal off either brass, pair them, or place one upon the other and try them for rock and squareness. Experience will teach us what to do in this and to bring them down uniform and square.

The engineer may request that a little draw be left, that is, that the brasses may be made small for the pin so that he may key them up. A word of warning —don't do it. Make your brasses come brass to brass, and make the brasses larger than the pin ratio 1/64 of an inch to 9 inches with clearance top and bottom of each brass one inch back to every four inches of diameter. To leave draw is to make trouble. If you want the brasses to work loose in the rod, if you want them to get knocked out of shape or run hot and probably cause a delay, leave some draw. But if you want to make a good job and have the satisfaction of knowing you have done so, make the brasses fit as if they were one solid brass instead of two halves.

In replacing, the value of knowing each part and what position it was in before, makes itself manifest. Examine all holes and be satisfied that the lubricant can do its work, and replace the brasses with some good oil on the pin, taking care that no foreign substance, such as ashes, filings or dirt, is allowed to get on that will cause heating. The wedge should be set to the old mark, and judgment only to be gained from experience used in increasing the pull of the wedge. These simple, practical rules will ensure good work and best results.

A Good Locomotive.

The following is an outline of an address delivered by Mr. Angus Sinclair, under the auspices of the B., C. R. & N. Mutual Improvement Class, Cedar Rapids, Iowa.

The object of the steam engine is to transform the energy of coal into mechanical work. The best steam engine and consequently the best locomotive is that which will do the greatest amount of work with the least possible quantity of fuel and the least expense for repairs. Designers of locomotives have had great structural difficulties to contend with in comparison to the makers of stationary

and marine engines, but with all the difficulties, the locomotive compares very favorably with any prime motor in popular use. But at best the locomotive is a comparatively defective machine. It only uses about five per cent. of the energy of the coal consumed. The margin of work in comparison to waste being so very small, great efforts have been made to produce a more efficient means of utilizing the energy in coal. This has brought the talk of electrical motors to the front, and many people think that electricity is the motive power of the future. But so far as we can see, there is little prospect of the hope being soon realized. Electricity as popularly used is not a prime motor. It has to be generated in a secondary way by machines driven by steam engines. Scientific men think that it will yet be possible to obtain electricity direct from the energy of coal, and if that dream be ever realized the days of the steam engine will be numbered. Some great inventions have been developed so slowly that it seems possible that electricity may yet be obtained direct from coal. It took 2,000 years to develop the steam engine and make it a practical machine after the force of steam was discovered, and it may be possible that electricity will be developed in a shorter time. Steam was developed under the pressure of necessity. The demand for better means for raising water than animal power afforded, set the philosophers of the seventeenth and eighteenth centuries struggling to apply steam to useful purposes. They knew the power that could be obtained from steam, but it seemed like a great giant which no man could handle until an unlettered mechanic, Thomas Newcomen, attacked the problem and applied the steam through a piston to a train of mechanism, and produced the germ of the steam engine, but he was only its improver, the same as was Oliver Evans of Delaware, in the United States, who improved on Newcomen's engine and produced the high speed, high pressure steam engine of which the locomotive is the highest type, about the time Watts was improving the Newcomen engine by applying a separate condenser.

The locomotive was first developed from the high pressure engine in England, through the necessity for transporting coal to the shipping stations, and was gradually improved by various mechanics and inventors. One of the first difficulties encountered in developing the locomotive was the mistaken belief that the wheels would slip on rails very readily without moving the engine forward. When the laws of friction became better understood among mechanics, it was found there was no difficulty from the cause if the cylinders were proportionate to the weight of the drivers. Mr. Sinclair gave some illustrations of friction with a sliding block and showed that the co-efficient of friction was constant, depending upon pressure. He showed that the power required to slip drive-wheels of a locomotive depended on the weight resting upon the wheels. If the cylinder capacity was too great for the adhesion the engine would be given to slipping, and calculations were made showing how this could be regulated. He said a conspicuous feature about a good locomotive was that the cylinder capacity was adjusted to agree with the weight of the driving wheels, the boilers being made large enough to supply sufficient steam to the cylinders without forcing. Numerous illustrations were given of proportions of boiler, cylinders and weight that gave the best results in actual service.

Phenomena connected with combustion were then taken up and a number of experiments given by fusing steel in oxygen, potassium in water, etc., to illustrate combustion. He proceeded to show that the laws of combustion operating in the experiments, regulated combustion in the firebox of locomotives, and that if these laws were not followed and regarded, waste of fuel would ensue. He insisted that it was the duty of locomotive engineers and firemen to study the laws of combustion and apply them to their work, and that a man was not master of his business unless he understood the principles regulating his business. Detailed remarks were made about the practice of firing and about the quantity of air necessary under various conditions of coal burning. In every case he made out that ignorance and carelessness produced waste of valuable fuel, and that railroads ought to have no use for men who did not care to make themselves proficient in their calling.

The generation and use of steam was next taken up, and Mr. Sinclair dwelt at considerable length on the space occupied by steam at various pressures, its temperature and capacity for doing work. He followed water from the temperature of melting ice till it was evaporated into steam at ordinary boiler pressure, showing the amount of heat expended in the operation. Reversing the journey, he traced the steam backward from the boiler to the cylinder, estimated the amount of work usually taken out by expansion and demonstrated the cause of the small measure of heat economy possible with a steam engine.

The lecture was illustrated by a large drawing of a locomotive and by sketches made on a blackboard. In conclusion, the speaker urged upon the young men composing the B., C. R. & N. mutual improvement class the necessity for acquiring a knowledge of the principles of engineering if they desired to rise above the position of a mechanic. The lecture was listened to very attentively by a large and critical audience, and at the conclusion the speaker was heartily cheered and overwhelmed with questions. —*Cedar Rapids Gazette.*

Diesel Locomotive.

The steam locomotive has had many threatened rivals during the past few years, and now the internal combustion motor is to be tried on the Prussian State Railways, says *The Locomotive*, of London.

The locomotive is the design of Dr. Diesel, and the engine has been constructed at the Winterthur Works of Messrs. Sulzer, while the underframe and gear has been built by Messrs. A. Borsig, of Berlin. The motor is of the four-cylinder type, working on the single acting two-cycle principle, and capable of developing normally about 1,000 b. h. p., though this may be exceeded. The engine drives a loose shaft to which the two driving wheels are coupled, the locomotive having two four-wheeled bogies. To accelerate at starting and develop greater power on inclines, an arrangement has been devised by which an auxiliary supply of fuel and air is provided for the cylinders.

The weight in working order is between 88 and 90 tons, and the length over buffers 55 ft.

Units of Measure.

The editor was taught by his governess that three barleycorns measured one inch, and at the mature age of six years he determined to test the accuracy of this statement. He had no difficulty in finding the barleycorns, but somehow no three grains that he picked up in the chickens' yard agreed with the formula. He never attempted the more scientific test which is thus described: "The length of a pendulum oscillating in a second in vacuo at sea level in the lattitude of London is 39.13929 inches, and from the knowledge of this fact the standard of the inch, foot and yard can easily be obtained should the official standards at any time be lost or mislaid." When in 1834 the "standard" measure was destroyed by fire at the house of parliament an attempt was made to restore it by the pendulum test, but pendulums, like barleycorns, were found not to agree.

The American Flexible Bolt Company, of Pittsburgh, is a new manufacturing concern of which Mr. C. A. Seley, formerly mechanical engineer of the Chicago, Rock Island & Pacific, is president and leading spirit. The bolts to be made are of a form invented by Mr. Ethan I. Dodds, formerly connected with the Erie Railroad. We expect to be able in an early issue of Railway and Locomotive Engineering to present the particulars in regard to this and other devices being introduced by this enterprising company.

Catechism of Railroad Operation

Questions and Answers.
Second Series.

(*Continued from page* 171.)

Q. 31. (b) Why is it necessary to place the engine on the dead center while keying up side rods?

A. 31. a. Would place engine on back dead center on a straight level track having wedges properly set up, would key main connection first. Where two keys are used in main connection would drive one key out and drive the other key down as far as it would go and mark it above the strap, then drive that key out and drive the other one down and mark it in a like manner, then drive that one out and drive both keys down at the same time so that when the brass was properly adjusted the mark on both keys would be the same distance above the strap. Then key back and front, although it is seldom that any keys are being used in back or front end of side rods. Then place engine on front center and try the rods. It is very essential that the rods be kept keyed up properly in view of the fact that any lost motion will cause pound, which in time may cause the bearings to heat, brasses to break, jar nuts and bolts loose and sometimes breaking driving boxes of frames and doing damage in general.

(b) In order to avoid keying the side rods too long or too short, or so as to key the pin centers the same distances apart as the journal centers.

Q. 32. How often does the ordinary locomotive exhaust steam during a revolution of the driving wheels, and at what point does the exhaust take place?

A. The ordinary locomotive exhausts four times, two from the right and two from the left. The exhaust takes place as the pin is traveling from the eighth to about the sixteenth, that is, if the engine is being worked at a very short point of cut off the exhaust will occur very early on the eighth, while if she is being worked at full stroke the exhaust will not take place until the pin reaches about the sixteenth.

Q. 33. What is meant by the engine out of tram?

A. An engine is said to be out of tram when the journal centers on one side of the engine does not correspond with the journal centers on the opposite side; for example: In tramming the engine, supposing the tram showed the journal centers on one side to be exactly 7 feet and the same journal centers on the opposite side to be 7⅛. The indications of engine being out of tram will usually be shown by the flanges cutting or wearing sharp on one side of the engine.

Q. 34. (a) What would you do in case of a throttle becoming disconnected while closed?

(b) If while open?

A. 34. (a) Would be governed largely by conditions; if on a busy main line, would be prepared to be towed in, while if on some branch line or at some isolated place would reduce all pressure, remove the dome cap and connect up throttle. If for a short distance no preparations would be necessary for towing; if long distance and cold weather, the choke plugs could be removed from the lubricator and sufficient lubrication conveyed to the steam chest and cylinders without disconnecting; however, if it is the wishes of the road, the valve rods can be disconnected and the cylinders lubricated through the relief valves by blocking the valves in one end of the steam chest.

(b) In the event of the throttle becoming disconnected while open the pressure can be reduced to where the injectors will work properly and the engine and a few cars handled by means of the reverse lever and brakes, or if it is so desired, where we have a clear road the crew and despatcher may be notified and the full train handled into the terminal.

Q. 35. If an engine is to be towed in dead, with main rods up, what would you disconnect, the slide valve, piston and young valve engine? How in freezing weather?

A. 35. Where slide valve engine is to be towed in dead with main rods up the valve rods can be disconnected and the valves clamped in opposite end from relief valve and cylinder lubricated through the relief valve. This will also prevent back pressure accumulating in the cylinder, as one end of the cylinder will be connected with the exhaust and the other with the atmosphere through the relief valve. A piston valve engine can be handled in the same way in the event of having relief valves or where by-pass valves are used one of the by-pass valves can be removed which will provide ample means for lubricating. In the event of a young valve, by disconnecting the valve cranks the valves can be blocked so as to open one to the exhaust and one end to the cylinder, thereby preventing any back pressure, lubricating the cylinder through indicator plugs or relief valves. In addition to this work in freezing weather the water must be let out of the tender and all parts of the boiler lubricator and all drain cocks must be opened in order to prevent freezing and causing damage to the engine.

Q. 36. If you do not take down the main rod on disabled side of engine, how would you arrange to lubricate the cylinder?

A. On roads where it is permissible the valve can be blocked with the back port slightly open and remove the back cylinder cock or block it open. Where this is not desirable, remove the indicator plugs or slack off on the front cylinder head.

Q. 37. If the engine is disabled on one side and main rod and piston is left up, and engine stops on dead center, how can you get engine started?

A. Unclamp and move the valve on the disabled side so as to admit a little steam into the cylinder moving the engine off the dead center, replace the valve and clamp it again. In the event of the main rod not being up, this method could not be used; therefore some other method would have to be resorted to. Some times driving a cold chisel between the wheel and the rail and pumping the engine will move her off the center.

Q. 38. (a) What is a by-pass valve, and what are its uses?

(b) What is a suction valve? What is its purpose?

A. (a) A by-pass valve is a sort of a bottle-shaped valve connected to the live steam passage way at the large end and to the admission port at the small end. Its uses are to relieve the cylinder of any excess pressure above boiler pressure during compression, also to assist in drifting. There are different kinds of by-pass valves used, some of them performing the duties of a by-pass valve and relief valve and are classed as combine vacuum and by-pass valve.

(b) A suction valve commonly called a relief valve is for the purpose of allowing air to flow in freely from the atmosphere while the engine is drifting, thereby preventing the air passing down through the stack carrying hot air and dust into the cylinder.

Q. 39. (a) If a by-pass valve was broken, how would you test for it?

(b) If a suction valve, how would you block for it?

A. 39. (a) In the event of a broken by-pass valve while running, the blow would occur as the piston was traveling towards the defective by-pass valve. It

should also be borne in mind that the combine vacuum and by-pass valve may permit steam to blow out to the atmosphere. To make a standing test, place engine on top quarter on side to be tested, lever in full gear ahead, block the wheels or set the brakes with cylinder cocks open, give engine steam. If steam shows at front cylinder cock and at the stack it indicates that either the cylinder packing is blowing, valve rings or by-pass valve. Move lever up past the center. If the blow stops at the stack but continues at the front cylinder cock, it would denote by-pass valve blowing bearing in mind, however, that cylinder packing or valve rings will usually blow on both strokes. While a by-pass valve will blow on one stroke only.

(b) As to just how this valve should be blocked will depend somewhat on the nature of the breakage. Usually by removing the cap and blocking the valve solid to its seat, holding the block down with the cap will be sufficient.

Q. 40. (a) Describe the piston valve, and state how it differs from the ordinary slide valve? Do all piston valves work the same?

(b) Describe the young valve.

A. 40 (a) A piston valve is usually a built-up valve in the form of a spool shape, having a piston on each end and a sleeve in the middle. The pistons are provided with packing rings which operate in a tight fitting bushing. Some piston valves, however, are solid on the ends, while others are hollow, allowing the exhaust steam to pass from one end of the valve to the other. These are supposed to be more perfectly balanced valves than those that are solid on the ends; also some are outside admission and some are inside admission.

(b) The young valve consists of two rotary valves located above the cylinders, having their axis at right angles to the axis of the cylinders. These valves are connected together and operated by means of valve cranks, valve links, wrist plate and rocker arm. The valves receive their motion through the regular Walschaerts valve gear or Stephenson link motion. The motion of these valves is such that while one valve is admitting to one end of the cylinder the other is acting as an exhaust valve.

Q. 41. (a) What is a balance slide valve?

(b) How is it balanced, and why?

(c) What is the hole drilled through the top of the valve for?

A. 41. (a) A balance slide valve is an ordinary slide valve having its upper surface protected from live steam.

(b) It is balanced by means of balance plate, springs, strips or rings. It is balanced for the purpose of making the engine easier to handle, reducing the friction between the valve and the seat, thereby making the engine more proficient in her work; also causes the valve to wear longer and requires less lubrication.

(c) The hole drilled through the top of the valve is to permit live steam that may pass in over the top of the strips to pass out to the exhaust, thus not destroying the balancing feature of the valve. It must be remembered, however, that while the engine is exhausting, exhaust steam can pass up through this hole in the valve to the space between the valve strips.

Q. 42. (a) In the event of a valve, valve stem, or yoke becoming broken inside of the steam chest, how can the breakage be located?

(b) After having determined on which side the defect is, how would you put the engine in safe condition?

(c) If on a piston valve engine? If on a young valve?

A. 42. (a) It is to be presumed that when a valve stem, or yoke, breaks, that the accident happens while running we will, therefore, consider these breakdowns first while the engine is running. In the event of a valve breaking, steam will appear at one or both cylinder cocks and also at the stack, depending upon the nature of the breakage. Should a valve, stem or yoke break inside the steam chest it is more than likely that the valve will be pushed forward, opening the back steam port, permitting steam to appear constantly at the back cylinder cock. We will also lose two exhausts at the stack. The engine, therefore, will have a jerky motion. To locate while standing, place engine on quarter plumb, the rocker arms, and endeavor to cover the ports, open the cylinder cocks and throttle slightly; if steam appears at the cylinder cocks and stack, it would indicate a defective valve. To test for broken stem or yoke with steam in the chest, move lever back and forth and if steam cannot be changed alternately from one cylinder cock to the other we have lost control of the valve; therefore, would consider it a broken stem or yoke.

(b) On engine having relief valve in front of steam chest, would plumb the rocker arm, remove the relief valve and push the valve back against the broken part of valve stem or yoke, then replace the relief valve, admit a little steam to the chest to determine as to whether the ports are covered; if so, would remove the relief valve fitting a block so as to rest against the valve, the other end extending into the relief valve, disconnect the valve rod and clamp it, and arrange to lubricate the cylinder.

(c) For broken piston valve would be governed somewhat by the manner in which it is broken. In the event of it breaking in two in the middle, would remove the heads and block solid on both ends of the valve. If the valve was broken in such a manner that it could not be used for covering the ports, would prepare to be towed in, for broken valve stem would place block in the front end of chamber, clamping the valve rod at the back. For a broken young valve, would treat similar to piston valve, in the event, however, of a valve stem breaking the valve links could be removed and the valves blocked so as to cover the ports.

Mechanical Problems.

There are certain figures, constants and formulas that every intelligent engineer and mechanic ought to hold upon his memory as firmly as he hold the multiplication table.

To square a dimension is to multiply by itself.

The formula for finding the tractive power of a locomotive is particularly important. It looks complex but is really simple; $\frac{d^2 L p}{D} = T$. and means:

d^2 = diameter of cylinder in square inches.

L = length of stroke in inches.

p = means effective steam pressure on piston.

D = diameter of driving wheels in inches.

T = tractive power on the rails in pounds.

The steam pressure is taken as eighty-five per cent of gauge pressure.

Ten per cent is taken off the tractive power to allow for friction.

To find the area of a circle, $d^2 \times .7854$ = area of circle.

To find circumference of a circle when diameter is given, diameter x 3.1416 = circumference.

The moving of one pound one foot high in one minute is called a foot pound. The raising of 33,000 pounds one foot high in one minute or its equivalent is called one horse power. In all calculations of work performed, the time required for the operation is always of supreme importance.

Hours of Labor.

A curious case has been decided in Texas, where there is a law restricting the working time of telegraphers to nine hours per day. It appears that the Houston Belt & Terminal Company worked towermen twelve hours per day, holding that legal because the men used telephones instead of telegraph instruments. The company was prosecuted for violating the law and the United States Circuit Court of Appeals has rendered a decision against the company. The towermen will in the future work nine hours a day or night.

Pacific Type of Locomotives for the Erie Railroad

The Lima Locomotive Corporation is showing a commendable enterprise in extending its constructive work to all branches of locomotive building. As is well known the Lima Locomotive and Machine Company which the new corporation succeeded last year had achieved an enviable reputation in the construction of switching, industrial and geared locomotives of all sizes and gauges, and in the special branch of constructing what is known as the Shay geared locomotive the company had practically the field to itself. In logging and other work the geared locomotive is peculiarly fitted, being slow moving and powerful, while the material and construction has always been of the best.

The new corporation, however, bids fair to take a leading place as builders of high speed locomotives suitable for passenger or fast freight service. Recently the Erie Railroad Company has placed in service a number of superheater Pacific type locomotives which were built at the works of the Lima Locomotive Corporation, and have already received the highest degree of commendation from the Erie officials and engineers. In fast passenger service they will compare favorably with anything of their dimensions, in railroad service.

As is shown in the accompanying illustrations the boiler is of the straight-top kind, 79 inches in diameter. With the introduction of superheated steam, the pressure has been kept at 185 pounds. The cylinders, however, being 27 inches in diameter by 28 inch stroke admits of a powerful starting force, the tractive force being rated at 40,566 pounds, the factor of adhesion being 4.34, which is very high even in a locomotive of this type. The total weight of the engine is 287,000 pounds, of which 57,000 pounds is the weight on the engine truck, 176,000 pounds on the drivers, and 54,000 pounds on the trailing truck. The driving wheel base is 14 feet, with a total wheel base of the engine amounting to 36 feet 2 inches. The total wheel base of engine and tender is 68 ft. 4½ inches.

The superheater is of the Schmidt top-header type, and the steam is conveyed through outside pipes, and the distribution is controlled by piston valves 16 inches in diameter. The valve gear is of the Baker type which is coming into much favor among the Erie railroad men.

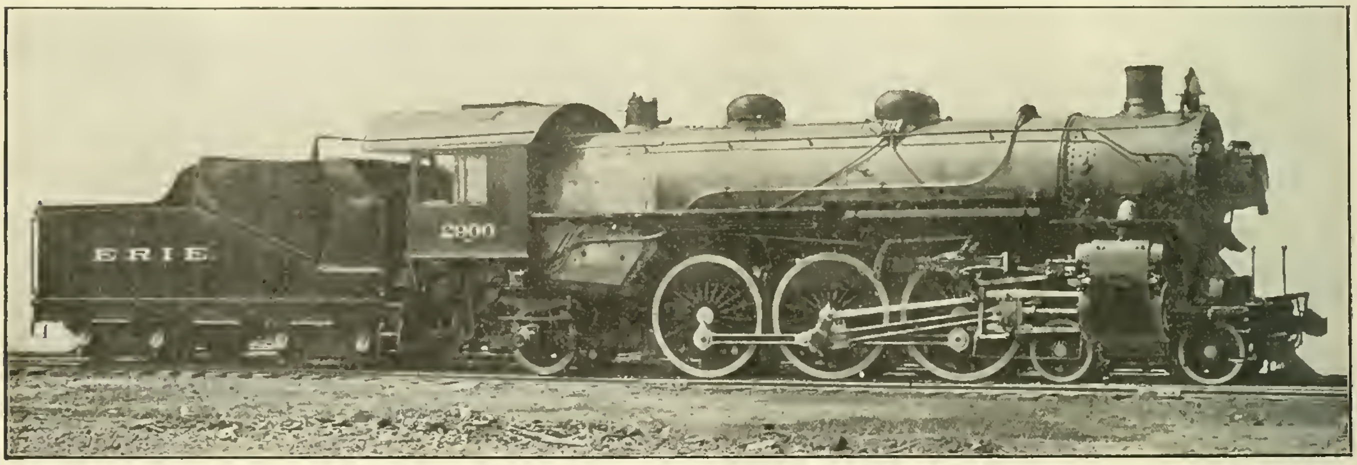
In regard to the firebox the dimensions are 114⅛ inches by 84 inches. There are 199 tubes 2¼ inches in diameter and 32 large flues 5½ inches in diameter to accommodate the superheater tubes. The flues are 22 feet in length. A Security section fire brick arch rests on four tubes 3 inches in diameter, with a heating surface of 27 square feet. The firebox heating surface amounts to 203 square feet, while the heating surface of the tubes is 2,567 square feet, and the heating surface of the large flues 1,010 square feet, making an evaporative heating surface of 3,807 square feet.

The tender is of the water bottom type with a capacity of 8,500 gallons, fuel, 14 tons. A Ryan and Johnson coal passer is attached to the tender. The weight when loaded is 182,000 pounds, making a total weight of engine and tender of 469,000 pounds.

The other general dimensions are as follows: Gauge,, 4 feet, 8½ inches; height, 15 feet, 6 inches; width, 10 feet, 8 inches; superheating surface, 790 square feet; diameter of driving wheels, 79 inches; engine truck wheel diameter, 37 inches; trailing truck, 33 inches diameter; frames, 12 inches by 13 inches, channels with trussed cast steel body bolster; main journals, 11 inches by 21½ inches; other bearings, 11 inches by 13 inches.

A notable feature in the construction of these locomotives is the excellent materials of which the various parts are constructed as well as the marked superiority of the various appliances and attachments with which the locomotives are equipped. The following list gives in detail particulars in regard to the material and names of the manufacturers which are a guarantee that no pains have been spared to make the locomotives equal to the best of their kind.

Frames—12 in. and 13 in. channels, with trussed cast steel body bolster. Journal boxes — Symington. Bearings — Brady brass. Chafing plate—Radial Buffer Co. Draftgear—Westinghouse friction. Coupler—Gould. Hose—Anaconda. Metallic conduits — McLaughlin. Brakes — New York system. Brake beams—Simplex. Grease cellars—Franklin. Crossheads—Alligator type of cast steel. Main and parallel rods—Vanadium steel. Cab—steel. Bumper-front — Pressed steel. Cylinder bushings, valve bushings, valve and piston rings—Hunt Spiller metal. Lubricator—Chicago, Type D-4. Piston rod and valve stem packing—U. S. King type. Driving tires—Latrobe. Flange lubricator — Chicago. Sanders—Leach, double. Brakes—N. Y. Lt'd. Steam heat—Ward system. Couplers—Gould. Headlight—Dressel, oil. Bell ringer—Simplicity. Whistle—6-inch chime. Blow-off cock—Fairbanks. Injectors—Ohio No. 12, non-lifting. Injector check—Hancock, top check. Ash pan—Tallmage. Fire door—Franklin No. 55. Flexible staybolts—Tate, full installation. Steam gauge—Ashcroft. Water glass—Klinger. Safety valves—Consolidated. All bearings—Vim metal.



4-6-2 PACIFIC TYPE LOCOMOTIVE FOR THE ERIE RAILROAD.

Wm. Schlafge, Gen. Mech. Supt. Lima Locomotive Corporation, Builders.

Questions Answered

EXPENSE OF SUPERHEATERS.

W. G. L., New York City, asks: If the saving of a superheater engine over one using saturated steam is put at a given figure, say 20 per cent., what would be the approximate saving if the greater prime cost, repairs on the superheater, extra wear on valves and cylinders, and extra oil were included in the calculation? A.—In the many reports that come to us in regard to engines where superheated steam is used these things have all entered into the calculations. Otherwise the estimates would be of no value. If the prime cost and maintenance of superheating apparatus were more than the gain in the saving of fuel and increase in power the apparatus would be worse than useless. The leading experts both in America and Europe agree that there is a real gain of at least 15 per cent., including every kind of expense, by the use of superheated steam. Some reports are as high as 25 per cent., but the average working results are, of course, more useful than results obtained under test conditions, as the latter have only a more or less academic value. In the matter of maintenance it may be added that the opinion is almost universal that the maintenance of the superheater entails no additional expense over non-superheater engines.

BAD BALANCING AND OTHER TROUBLES.

J. F. S., Galeton, Pa., asks: What will be the effect on a consolidation type of locomotive if the drivers are improperly counterbalanced and the frames are down so low on the driving boxes that one or more of the spring pockets ride on the frame so that the equalizers cannot distribute the shock when passing over uneven track? And what will be the effect on the track in case soft ballast is in use? And what effect will these conditions have on the riding qualities of the locomotive, and also on the rails in intensely cold weather? A.—The effect upon the locomotive would be of the most pernicious kind. In regard to the improper counterbalancing the effect is to give an unsteady motion to the locomotive which no amount of momentum can completely overcome. In cases where the frames strike the top of the driving boxes the tendency to frame breakage, generally near the pedestals, is very great. As to a soft ballasted track, the hammer blow of the badly balanced revolving parts would tend to superinduce and add to inequalities in the track. More prominent probably, and certainly more continuously, would be what is known as the riding quality of the locomotive. It would be of the worst—full of eccentric vibrations, rendered insufferable by intermittent shocks sufficent to loosen the teeth of the unfortunate engineer and fireman. In frosty weather the tendency to rail fracture would, of course, be much greater than on well-balanced engines properly mounted and running on a properly ballasted track. It may be added that the complete repair of the track is a serious matter, but the proper balancing of the revolving parts is a comparatively easy job, while the shimming a shortening of the spring hangers is a mere trifle in the hands of skilled mechanics.

VARYING TEMPERATURE.

W. L. B., Bonanista, Newfoundland, asks: Will atmosphere pressure balance a column of water at the standard temperature, higher than it will at its greatest density? A. The rule for finding the volume of one pound of air at 14.7 pounds pressure, at any given temperature and pressure is:

$$V = \frac{T + 461}{2.7074 \times P}$$

Where V = volume of air in cubic feet.
T = temperature of air in degrees Fahr.
P = pressure in pounds per square inch.

From the above formula we have:

$$P = \frac{T + 461}{2.7074 \times V};$$

$$T = (2.7074 \times P \times V) - 461.$$

WEIGHT OF WOOD AND WATER.

J. R. N., Milwaukee, writes: We had some roundhouse discussion here about the weight and specific gravity of certain kinds of timber, the general opinion being that ebony was the only kind of wood that was heavier than water. We agreed to ask your opinion in regard to this, and will be looking for a reply in an early issue of RAILWAY AND LOCOMOTIVE ENGINEERING. A.—There are quite a number of different kinds of wood the average weight of which is heavier than water. Among these besides ebony, the average weight of which is 76 lbs. per cubic foot, water being 62½ lbs. per cubic foot, there is box wood, weighing 70 lbs, live oak 69 lbs. Some kinds of mahogany and lignum vitae are also heavier than water, but it must be remembered that the condition of the timber is an important factor in any calculation looking to the comparative weight of timber.

COMPARATIVE STRENGTH OF SOLID AND WELDED METALS.

W. E. H., Rocky Mount, N. C., writes: There are many blacksmiths and other mechanics who are of opinion that the welded portion of a bar or plate is stronger than any other part of the metal. Is this the case? and what is the relation between the welded and solid parts of iron and steel? A.—The welded part is much weaker in all cases. The variation depends greatly on the form of the part. Many tests have been made to ascertain as nearly as possible the exact ratios, but the variations shown by these tests have been considerable owing to the unavoidable variations of workmanship in welding. In the case of iron tie bars, the strength of the solid bar varies from 43,201 to 57,065 lbs. In the case of welded bars of the same dimensions, the tensile resistance has shown variations running from 17,816 to 44,586 lbs., the average approach of the welded to the solid bar being about 79 per cent. In the case of plates the variation is about 83 per cent. in the best tests. In electric welding the average is higher, being about 89 per cent. In steel bars and plates, solid steel shows a resistance ranging from 54,226 to 64,580 lbs. per square inch. Welded bars or plates show a strength at the welded part ranging from 28,553 to 46,019 lbs.

TRIPLE VALVE TEST.

C. H. K., Sunbury, Pa., writes: Would you please explain the action of the differential valve of the Westinghouse Triple Valve Test Rack, in testing triple piston packing rings? A.—With the valve in its proper position auxiliary reservoir pressure is above the diaphragm of the differential valve and brake pipe pressure under the diaphragm, the triple valve being in lap position when valve "B" is moved to position No. 1.

When valve "A" is then moved to position No. 2 the pressure flows underneath the diaphragm as well as to the brake pipe side of the triple piston, the rate of feed being regulated by valve "J," and with lever "D" in the proper position the diaphragm should yield and open the vent valve before brake pipe pressure is raised high enough to force the triple valve to release positon.

The steady discharge from the vent port then insures that the required differential in pressure is being maintained while the packing ring leakage, if any, is being noted. You understand, of course, that the triple valve must not move to release position at this time, if it does it indicates very low friction or possibly a leaky graduating valve and when triple valves are lubricated with dry graphite a special attachment is required for testing them.

This valve, which is merely an improvement over the weighted valve "K" of the former test racks, consists principally of this diaphragm, vent valve and weights to be used in the friction tests, the number of weights being suspended depending upon the position of the lever "D."

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The Railway Master Mechanics' Convention.

A superficial examination of the program outlining the business arranged for the June meeting of the Railway Master Mechanics' Association gives the impression that much important business will occupy the attention of the members, for no less than fifteen reports and two individual papers will be read; but critical consideration of the subjects to be reported upon leads to disappointment. With one or two exceptions there is no live question among the fifteen subjects to be discussed. We consider the Committee on Subjects the most important on the list, for its members have the opportunity of selecting subjects for investigation and discussion that will make future conventions compare favorably with those that brought to the Railway Master Mechanics' Association the reputation of holding the most interesting and valuable conventions relating to railway questions.

The personel of the various committees consists of the most able and hard working members of the asociation, but the subjects they are called upon to investigate are nearly routine that give very little opportunity for zealous work. The preparation of committee reports is highly important work, but unless the subject is of the character that is likely to bring out new information, the duty of preparing the report is generally neglected till close upon the meeting of the convention, and the matter prepared is of little value.

Most of the reports to be submitted to the 1913 convention will be practically reports of progress which are valuable enough in their way, but add little to the knowledge which railway mechanical men are striving to obtain. If a subject is of a character that exites active discussion on the floor of the convention, it performs the best service possible for the members because the more valuable information concerning railway practices and mechanical improvements has been brought out in discussion.

The reports that are records of the year's progress are—revision of standards, with Mr. W. E. Dunham as chairman; mechanical stokers, Mr. T. Rumney, chairman; main and side rods, Mr. W. F. Kiesel, chairman; safety appliances, Mr. D. F. Crawford, chairman; smoke prevention, Mr. E. W. Pratt, chairman; specifications of material used in locomotive construction, Mr. C. D. Young, chairman. What we regard as the most important subject on the list relative to superheaters, a report on the subject being due from Mr. J. T. Wallis, and a personal paper on the same subject by Dean C. H. Benjamin, of Purdue University. Both these investigators are in a position to give accurate information about locomotive superheaters, for Mr. Wallis has the use of the locomotive testing plant at Altona, and Dean Benjamin has no doubt made experiments on the locomotive testing plant at Purdue. The indications are that superheaters are fuel-saving appliances for locomotives, but exact information concerning their efficiency and durability is desirable.

"Smoke prevention" is a well worn subject, but it is always with us, and it is still possible to obtain information that will help to clear the atmosphere. The report on the subject will be prepared by Mr. E. W. Pratt, and he has a very strong committee to give co-operation, consisting of Messrs. J. F. DeVoy, W. C. Hayes, T. R. Cook, and M. K. Barnum. When it is possible to stand on a building overlooking a great railway yard, where locomotives belonging to four or five railways are passing and repassing, the engines of some roads vomiting black smoke incessently, while those belonging to other companies are nearly smokeless, the beholder naturally concludes that the personal equation has much to do with smoke prevention.

Taxing Incomes.

There is decided opposition to the scheme of the present American Congress to impose an income tax, but the legislators display sufficient self protection to prevent the tax from hitting the mass of voters. The statesmen of foreign countries are not so considerate. Nearly every person above the rank of laborer on German railways are required to pay income tax. What seems even worse than that the German government is proposing to tax the income of trade unions and the funds of the workmen's leagues. Increase of the army is demanding this cruel line of taxation.

Safety Under Standard Train Rules.

The Standard Code of Train Rules of the American Railway Association is the result of years of conscientious study and experiment. The code is employed today in the operation of every important line in the United States, Canada and Mexico. The committee on these train rules has embraced in its membership, from first to last, forty-eight railway officials. These officials have held positions of all kinds, ranging from division superintendent and superintendent of telegraph to president at the time of their service. In their several experiences in railway work they represented all sections of the country, and, from their first railway service to the last, they filled nearly every possible position in the operating department.

Yet the rules thus formulated are frequently the subject of criticism by the Interstate Commerce Commision. There was recently, says the New York *Times*, a collision in Ohio of a freight train which resulted in the death of one person. The flagman of the train run into went back 1,900 feet from the rear of his train, and on being called in lighted a red fusee and placed on the track 1,500 feet to the rear of his train.

In spite of these cautionary and emergency signals on the track, however, which, of course, supersede all other running and signal rules, this freight train, Extra 8,188, at the time of the collision was still running at the rate of fifty miles per hour. The comment of the commissioners on the situation is as follows:

"With regard to Flagman Wheeler's failure to go back further it may be noted that he violated no rule. In stopping 1,900 feet to the rear of his train he evidently exercised his best judgment as to what was a sufficient distance to insure full protection. His error in judgment but serves again to illustrate the weakness of the company's flagging rule, Standard Code Rule No. 99."

Now, with all respect to the Interstate Commerce Commission, it does nothing of the kind. It simply serves to illustrate

the weakness of any one rule in the presence of reckless disregard of others. Tinkering with good rules or changing them to bolster carelessness elsewhere or lack of proper supervision on the part of management is wrong in principle. The rule in question is as follows:

"When a train stops or is delayed under circumstances in which it may be overtaken by another train the flagman must go back immediately with stop signals a sufficient distance to insure full protection. When recalled, he may return to his train, first placing two torpedoes on the rail when the conditions require it."

As a matter of fact, this flagging rule is probably the most difficult, the most debatable one in the whole code. Such as it is, it represents the consensus of opinion of those best qualified to be judges. The information for the public in these matters relates to the qualifications and methods of the men who are responsible for these rules. Are they or are they not the very best men obtainable for this purpose?

The Hydraulic Jack.

The announcement of the death of Mr. James Tangye, one of the Tangye brothers so well known in British mechanical circles, has brought the question of the invention of the hydraulic jack prominently to public notice, and while it would be very unjust to endeavor in any way to belittle the excellent work of the accomplished English engineers, two of whom, Sir Richard and James are now dead, and George, who is still living, at the same time there is no good sense in crediting to any member of the distinguished family an invention with which they had little or nothing to do. In the public announcement of the death of Sir Richard Tangye some years ago the portable hydraulic jack was claimed to be of his invention, and now, last month, the same British journals, and even some in America that ought to be better informed, are crediting James Tangye as the engineer who introduced the jack, and even going so far as to remark that it is a curious fact that this masterly appliance has remained very nearly unaltered until the present day just as it came from the pencil of the English engineer.

The facts in regard to the first appearance of the portable hydraulic jack are briefly these: Richard Dudgeon, a Scottish machinist who emigrated to America in the early forties, an inventor of marked ability, and latterly a very successful manufacturer of hydraulic jacks and other mechanical appliances, and whose works established by him are still in very successful operation, invented and perfected the jack, and shortly after its introduction and practical operation in America, Mr. Dudgeon proceeded at the earliest opportunity afforded him to introduce his invention in Great Britain. He secured a patent in London, and his priority of claim was never disputed. Several years after the introduction of his masterly invention in Great Britain, it came into very prominent use in the launching of the steamship "Great Eastern," as the weight of the vessel had sunk the hull into the shipyard several feet and rendered the launching an engineering problem of considerable difficulty. Brunel, the eminent British engineer, who designed the "Great Eastern" made use of the hydraulic jack in raising the vessel, and the Messrs. Tangye cooperated with Brunel in the construction and application of Mr. Dudgeon's hydraulic jack, and from this circumstance arose an impression among those who were not well informed that the appliance was invented or introduced by the British engineers.

It may be added that among Mr. Dudgeon's other inventions the tube expander came immediately into great popular favor. It was first applied in the construction of a steam road carriage constructed by him, and which may be properly said to have been the forerunner of the automobile. His application of a balanced valve on the steam hammer was also a marked improvement, and rendered possible the vast increase in the size of steam hammers. His experiments also in aerial navigation are among the first recorded, and if the gasolene motor had been in use at that time, he would have developed the flying machine, as nothing but the weight of the steam engine used in his experiment precluded the sustained flight of his machine.

To Make Repairs Easy.

At some season of the year every railroad company in the country is short of power, and at these times a locomotive is from twice to ten times its ordinary value to the company. These are the times when the engine houses are certain to get filled up with locomotives requiring repairs that will make them miss some trips. One has a cylinder-head broken, another is laid up with a broken eccentric-strap which twisted the rods and called for adjustment. A broken valve stem is holding an engine in, and another is bound to be idle for a day or two because the draw-bar of a caboose went through the front casting of the smokebox. It is needless to enumerate the small disorders or breakages that are keeping other engines in shops when the transportation department is harassed with cars waiting to be moved. The delay of locomotives waiting for small repairs at times when the road is overcrowded with business is a fruitful source of disturbance and of animosity between the operating and the mechanical departments.

Every master mechanic who takes an intelligent interest in his business can readily see the saving of time that would result in the repairing of locomotives if parts were kept in stock ready to put on when an engine came in broken down. Those who do not recognize the importance of this are not a credit to the business. It is over half a century since the more advanced class of railroad mechanics began advocating the use of interchangeable parts for rolling stock repairs. For twenty-five years expatiating on the advantages of an interchangeable system has monopolized the time of railroad men's meetings, and the pages of the engineering press. Few men in charge of railroad rolling stock are to be found who do not indorse the interchangeable systems and are roads where duplicate parts are kept ready in stock for certain engines, and great saving of time is effected; but there is no railroad that has in practice the perfected interchange system followed in many other lines of machine work. The question naturally arises: Why do profession and practice disagree so thoroughly in this important matter?

The different superintendents of motive power, if asked to answer this question would reply, enumerating difficulties that beset his particular case, and we should receive a mass of conflicting testimony. A careful study of the question leads us to believe that the failure of railroad companies to put into practice a successful system of preparing interchangeable parts for repair work is due principally to the practice of depending upon drawings for dimensions, and on the two-foot rule for measurement. There are other obstacles that hinder the establishment of practical standards, such as the diverse character of the engines and cars purchased, but the real difficulty that has led to nothing, all efforts toward interchangeability is the blue print and boxwood rule. Both of these things are highly useful in their way, but as means for maintaining machine parts of the same size they are a failure.

The thing works in this way: A superintendent of motive power gets out drawings and specifications for a standard locomotive, and a class is established. Engines are built at different times and different shops, according to the drawings. In laying out the work for the different parts a scribe line is put one inch to one side, dividers have led to 1/16-inch error in another place, and the trifling mistakes of those who lay out and of those who execute add up till very few of the parts can be taken from one engine and put upon another without fitting.

It is gratifying, however, to know that a general improvement in these particulars is being marked in many railroad shops.

Where Railroad Earnings Go.

The enemies of railroad interests try to make people believe that railroad earnings are swallowed by grasping stockholders who use very little of the money for the benefit of the American people. That idea is far from being true. In fact, most of the railroad revenues are devoted to paying the wages of the employes, and of course through that channel reach those who produce the necessaries of life. As an illustration, the Pennsylvania Railroad System last year paid $188,749,312 in wages and $108,209,372 as payment to capital.

These reliable figures prove that labor receives the greater share of the revenues and therefore has the biggest stake in the prosperity of railroads. The Pennsylvania Railroad Company can be fairly taken as representing all the railroads in the country, with the difference that its proportion of remuneration to capital is greater than most of the other railroad companies. Capital works for wages the same as trainmen do, and when the pay is cut down, strikes follow and railroad companies have difficulty in securing the capital necessary for the operation.

Inevitable and Preventable Heat Losses.

One of the first discoveries usually made by students of steam engineering is the fact that as a means of transforming the latent energy of coal into mechanical work, the steam engine is an extremely wasteful machine. Scientists have found that a pound of good coal represents about eleven millions of foot-pounds of energy. Very few steam engines develop one million of foot-pounds of work for each pound of coal used in the furnace, and engines utilizing 10 per cent. of coal are considered thoroughly first class. This percentage of waste appears enormous, and the novice readily concludes that mismanagement must be responsible for a great portion of the wasted power. But increase of knowledge brings a realizing sense of the tremendous difficulties that obstruct the way of radically increasing the efficiency of the steam engine.

There have been a great many prime motors invented for the purpose of converting the latent energy of carbon into mechanical work, and several of them have been capable of utilizing a greater portion than the steam engine of the heat energy employed; but none have been so reliable for every day work, and, with all its shortcomings and defects, the steam engine continues to be popular with all power users who find it important that their machinery be kept running day by day without interruption. In popular addresses we are continually hearing the prediction reiterated that science will yet lead the way in affecting radical improvements upon the steam engine. The past achievements of science in this direction have been exceedingly slender, and do not make the promises for future deeds very encouraging. The practical man, on the other hand, whose labors have done most towards developing and perfecting the steam engine, and whose opinions regarding future progress are entitled to the highest consideration, believe that its limit of possible economy has been nearly reached.

Although a steam engine that converts 10 per cent. of the potential energy of fuel into mechanical work may be regarded as a wasteful machine, it is not wasteful when compared with the great mass of engines running our railroad trains and our mills, for a very few of these utilize more than 5 per cent. of the heat stored in the coal used. The opportunity for railroad engine improvers at the present day appears to be in carrying out methods which will bring up the performance of the common 5 per cent. engine towards the high class engine that takes 10 per cent. dividend of the coal. The men who busy themselves with this problem may safely leave to others the work of improving what is now regarded as the high class engine.

The great avenue of waste with all steam engines is the exhaust steam, and there is no probability that the loss of heat passing out by this channel will ever be radically decreased, while steam is employed as a mode of motion. There are, however, lines of economy that may be worked on to advantage by our master mechanics and locomotive designers. Numerous minor causes of waste could be closed up by intelligent management, and the resulting saving would materially increase the economy of the engine. Even the most defective locomotive boilers in use are more efficient in giving back equivalents for the heat received than the best proportioned and best protected cylinders, yet it is easier effecting improvements on the boiler than on the cylinders. A good locomotive boiler accounts for over 50 per cent. of the heat liberated from the coal; few cylinders convert 10 per cent. of the heat of the steam entering them into mechanical work. Still with all its relative efficiency, there is much preventable waste going on in boilers, owing to faults of construction and careless or unskillful management. There is loss from bad proportion of grate surface and flue area, from the gases of combustion being improperly mixed, from defective means of admitting and restraining air supply, from the gases being passed over the heating surfaces too rapidly, from water being passed through the dry pipe along with the steam, and from radiation of heat due to defective covering.

The preventable losses in the cylinders are due to too limited expansion caused in various ways, to back pressure caused by faults of design and restricted exhaust opening, to attenuated steam line at short cut-off, and excessive compression resulting also from faulty design of the valve motion, and to condensation caused by imperfect covering.

Pointing out errors of design and causes of waste is, we admit, much easier than the work of effecting remedies. Wasteful practices and carelessness about details are apt to creep into the best conducted departments unless persistently checked by the responsible officers. The vigilance and labor that produce the checks must be ever awake, ever active, and when this is the case their effects are very apparent on the operating expenses.

Train Wrecking as Strikers' Weapon.

There are several labor strikes prostrating the business of Paterson, N. J., at present and the hatred of employees has taken the extraordinary form of attempts to wreck trains on the Erie Railroad, which passes through the town. It was only through the keen vigilance of the engineer of an express train that the first attempt at train wrecking was frustrated. Several more attempts of the same kind have been made, but an order has been issued for trains to be run slowly through that seat of mysterious war.

It is difficult to understand how the people who are quarrelling with mill owners expect to keep their cause by trying to murder innocent train men, workers like themselves and passengers who have no interest in labor disputes.

Train wrecking is regarded in much the same light as arson, or as wilful murder, since it involves a deliberate attempt to cause such shock and smashup as is likely to result in loss of human life, or in severe bodily injuries to passengers. The men or women who plan such outrages are considered enemies of society and dangerous criminals in all civilized communities. Their acts are constructive homicide, to say the least, and they understand perfectly well the natural results of their efforts to wreck trains.

A Mexican Incident.

A railway incident was nearly causing strained relations between Mexico and the United States government last month. An advertisement appeared in a Mexican newspaper in the City of Mexico which read. "All Americans wishing free transportation home should send their names and addresses to Dr. William Willey."

The result of that notice was a small hegira of Americans from Mexico and much alarm among Americans who were not ready to bundle and go. The privilege offered was suddenly stopped, but there is some mystery concerning its origin.

2-8-0 Type of Locomotive for the Boston and Maine Railroad

About two years ago, the Boston & Maine placed in service forty Consolidation type locomotives, which were built by the Baldwin Locomotive Works. These locomotives used saturated steam, and their successful performance is demonstrated by the fact that 50 additional engines of similar design have recently been completed for this road by the same builders. The new locomotives are equipped with superheaters, and the steam pressure has been reduced from 200 to 180 pounds. At the same time, the cylinder diameter has been increased from 22 to 24 inches, and this raises the tractive force from 40,500 to 43,400 lbs. The ratio of adhesion, in the case of the new locomotives, is 4.3.

The boiler used in this design is of the wagon-top type, with a long gusset in the middle of the barrel. The firebox is wide, and the depth of the throat is necessarily somewhat restricted; but it is sufficient for the installation of a sectional arch which is supported on four 3-inch tubes. The longitudinal seams in the barrel rings have "Diamond" welt strips, and are welded at the ends in accordance with the usual practice of the builders. The dome is of pressed steel, in one piece, measuring 29 inches inside diameter.

The superheater is of the Schmidt type. It is composed of 30 elements, and is arranged to connect with outside steam pipes. The steam distribution is controlled by 12-inch piston valves, which are set with a lead of 3/16 inch and a travel of 6 inches. These valves have a steam lap of one inch and an exhaust clearance of ⅛ inch. They are driven by Walschaerts motion.

These locomotives are equipped with acetylene headlights, mounted on the smoke-box door. The headlight tank is placed under the smoke-box extension, and is supported on brackets which are bolted to the cylinder saddle. Special attention has been given to providing a convenient arrangement of steps, handholds, and cab fittings.

The tender trucks are of the arch-bar type, with double elliptic springs, cast steel bolsters and chilled wheels. The longitudinal frame sills consist of 13-inch channels. The tank has capacity for 7,300 gallons of water and 12 tons of fuel.

In its general design, this locomotive follows practice which has proved successful on the Boston and Maine. Due to the use of superheated steam, a material increase in efficiency and capacity may be expected, as compared with the engines built two years ago; and this has been accomplished with an increase in total weight, of less than four per cent., and with comparatively little departure from the previous design.

The general dimensions are as follows:

Gauge, 4 ft. 8½ ins.

Boiler.—Diameter, 70 ins.; thickness of sheets, 11/16 ins. and ¾ ins.; fuel, soft coal; staying, radial.

Fire box.—Material, steel; length, 108 ins.; width, 71¼ ins.; depth, front, 70½ ins.; depth, back, 58 ins.; thickness of sheets, sides, ⅜ ins.; thickness of sheets, back, ⅜ ins.; thickness of sheets, crown, ⅜ ins.; thickness of sheets, tube, ½ ins.

Water space.—Front, 5 ins.; sides, 4 ins.; back, 4 ins.

Tubes.—Diameter, 5⅜ ins. and 2 ins.; material, 5⅜ ins. steel, 2 ins. iron; thickness, 5⅜ ins., No. 9 W. G., 2 ins., 0.109 ins.; number, 5⅜ ins., 30; 2 ins., 204; length, 14 ft. 9 ins.

Heating surface.—Fire box, 178 sq. ft.; tubes, 2,185 sq. ft.; firebrick tubes, 29 sq. ft.; total, 2,392 sq. ft.; grate area, 53.4 sq. ft.

Driving Wheels.—Diameter, outside, 61 ins.; diameter, center, 54 ins.; journals, main, 10 ins. x 12 ins.; journals, others, 9½ ins. x 12 ins.

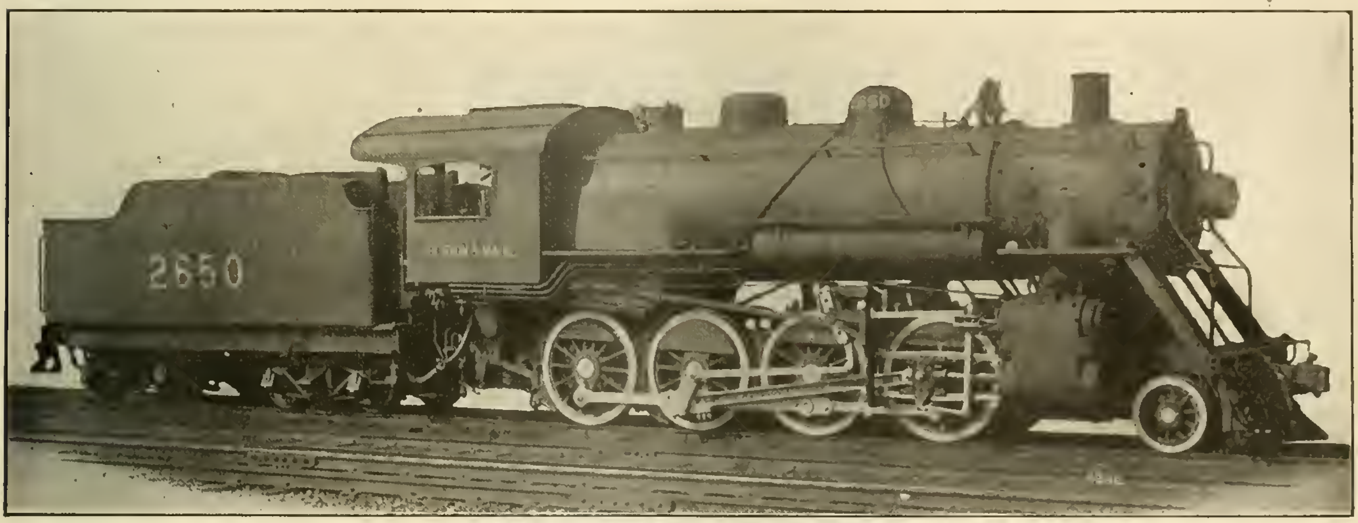
Engine truck wheels.—Diameter, 33 ins.; journals, 6 ins. x 12 ins.

Wheel base.—Driving, 17 ft.; rigid, 17 ft.; total engine, 26 ft.; total engine and tender, 58 ft. 2 ins.

Weight.—On driving wheels, 186,060 lbs.; on truck, 24,940 lbs.; total engine, 211,000 lbs.; total engine and tender about 350,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7,300 gals.; fuel capacity, 12 tons; service, freight.

Superheating surface, 522 sq. ft.



CONSOLIDATION TYPE LOCOMOTIVES FOR THE BOSTON & MAINE RAILROAD.

Henry Bartlett, Gen. Mech. Supt. Baldwin Locomotive Works, Builders.

Chemical Examination of Water Used on Railroads.

The latest fad which must be paid for by railroad companies is represented by an order issued by the Secretary of the Treasury requiring all common carriers in Interstate traffic to give all water provided for the use of passengers bacteriological and chemical examination at least every six months. Many manufacturing concerns supply much more water to human beings than railroads do, but no political glory would be obtained from harassing them, so they will remain exempt from annoyance.

Half an ounce of coal seems a small quantity to consider as an entity of motive power in transportation, yet that amount of fuel is sufficient to propel a ton of freight one mile in the operation of modern steamships.

Air Brake Department

Air Brake Convention.

The members of the Air Brake Association assembled for their twentieth annual convention at the Planters Hotel, St. Louis, Mo., Tuesday, May 6. The convention was formally opened at 9.30 a. m. with a prayer offered by Rev. C. E. Jenney, after which the members were welcomed to the city by the mayor's secretary, Mr. Rogers. The annual address of the president of the association, delivered by Mr. W. J. Hatch, was in the form of a brief resumé of the work done by the association, and an outline of the business now in hand.

The financial business and reports thereon were then heard and the presentation and discussion of technical papers was taken up. The first was on the subject of Undesired Quick Action, Its Prevention and Remedy, by Mr. C. N. Remfry. The paper dwelt upon an air brake condition on the Duluth, Massabe & Northern Railroad, where, during the year of 1907, 375 cases of undesired quick action were reported on 13,550 trains handled over the road. In 1908, 7,918 trains were transported and 4,021 cases of undesired quick action developed, whereupon the situation was deemed critical enough to warrant some prompt and radical action.

The paper stated that among other precautions to eliminate the disorder the use of dry graphite as a lubricant for triple valves was resorted to, and in 1909, but six cases of quick action were reported on, 11,571 trains handled and but one more case, due to a mechanical defect, was reported during the years of 1910-1911 and 1912.

These figures refer only to ore cars and to the writer such results are almost beyond belief, but we have no adequate reason for doubting the tabulated results shown in the paper. While the results were questioned by several of the members, the discussion hinged upon the benefits that are derived from the use of dry graphite on the slide valve and seat of triple valves.

Improper lubrication of the air pump cylinder and the effect of brake cylinder lubricant working into the triple valves as causes of undesired quick action were also spoken of, and questionable practices in triple valve repair work were pointed out as contributing causes of the disorder.

The triple piston bushing roller was very harshly criticised in connection with repair work.

Near the conclusion of the morning session Mr. Turner took the floor and disseminated some further valuable information on the subject, pointing out the reasons for some wrong impressions, and explaining in detail the proper use of triple valve lubricant and proved to the satisfaction of all parties that the surest way to produce undesired quick action was to use oil freely as a slide valve lubricant, and one of the most positive ways to prevent it was to keep the valve and seat perfectly free from lubricant or dry, stating that the recommendations for the use of dry graphite were in the nature of a compromise.

The afternoon session was devoted to an informal discussion or smoker, termed

L. H. ALBERS.
President Air Brake Association.

by some members as a "sand house" discussion which, by the way, has become one of the most valuable and interesting features of the conventions. The first subject was, the most suitable lubricant for the air cylinder of the pump, wherein it developed that the most successful method of lubricating the cross compound compressor is to cut out the lubrication or dispense with it in the low pressure air cylinder and lubricate only the high-pressure cylinder, but not in excessive quantities.

It was also pointed out that the superheat oil in many instances gums up air passages and in some cases accumulates on the steam valve mechanism to such an extent that the pump will not run until the main piston valve is taken out and the deposit removed.

Another subject was the arrangement of the air discharge pipes when two pumps or compressors were used per locomotive.

The final subject was to find some method whereby the obviously correct practices determined upon by the association could be brought to the attention of the railroad officers, and how they could be presented in a manner to carry conviction and bring favorable results. A committee was appointed to give a more thorough consideration to this most important matter.

On Wednesday morning the discussion of the causes and remedies for undesired quick action was continued. A representative of a western line cited instances in which trains leaving Chicago and St. Louis, for the west, with brakes operating perfectly, encountered no undesired quick action until reaching the mountain districts where changes of atmospheric temperature and atmospheric conditions occurred. Others told of instances where no trouble from this disorder occurred until after a number of applications of the brake had been made.

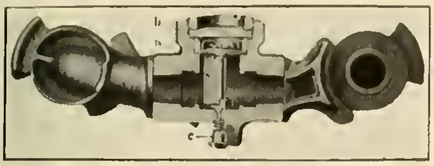
Mr. Turner also stated that a small quantity of moisture surrounding the triple slide valve was as effective as oil in excluding air pressure from the face of the slide valve, thus adding to the resistance to triple valve movement which tends to cause quick action.

As the capacity of compressed air to hold moisture varies directly with the increase of temperature and inversely with an increase of pressure, temperature remaining constant in the latter case, obviously a perfect condition of the compressor air cylinder as well as correct design and location of ample main reservoirs and correct piping installation is necessary to prevent as much as possible any deposit of moisture in the brake pipe or knowing that the moisture is always deposited where the temperature of the compression is lowered, we would not disregard a poor condition of the air cylinder of the pump as a contributing cause to undesired quick action.

The writer has made some experiments in the way of air cylinder inspection and maintenance as bearing upon this disorder and a future issue will contain further reference to this very important phase of air brake operation.

In order to promptly locate a "dynamiter" in trains of cars, the Westinghouse Air Brake Company furnish a device known as a Quick Action Indicator,

which we have referred to in previous issues. It is inserted between the hose couplings and a hand on the dial points in the direction in which the rapid brake pipe reduction originated.



SECTION VIEW OF QUICK ACTION INDICATOR.

At 2 P. M. Wednesday, Mr. W. V. Turner, chief engineer of the Westinghouse Air Brake Co., delivered his annual address to the members. His talk was on the subject of effect of changed operating conditions and modern rolling stock on the brake and what is being done to make this money saving or money losing apparatus as efficient as heretofore. The remarks were along the line of a paper prepared and read by him before the Pittsburgh Railway Club, in which his constant aim was, and is, to impress upon the operating officials of the railroads, the importance of the air brake in connection with the many railroad problems that are from time to time discussed by the various railway clubs.

It goes without saying that Mr. Turner is able to do this, and in a manner that cannot be appropriated by any other air brake man.

We will not at this time dwell upon his qualifications for handling any phase of an air brake problem, because it is impossible for any one to know anything about modern air brake equipments and their operation without having heard of Mr. Turner, or having read his contributions to air brake literature.

If our readers can realize just what has been accomplished in the air brake art during the past five years, or partly understand what was required and how many apparently impossible situations have been overcome and obstacles surmounted and then go into the subject far enough to get an idea of how each factor in every one of the problems was analyzed, how each deduction was made until the fundamental principles were found, then understand how the brake equipments were designed and built upon those principles, every one of our readers would agree that Mr. Turner is the greatest mechanical expert that the world has ever produced.

It may appear to be a pretty broad statement, but we say this because it is the opinion of scientific men and no other single line of individual effort has ever necessitated the combination of mechanical genius, literary ability and brilliancy of intellect that has been required to develop the air brake to its present state of perfection. This state of perfection does not mean simply the E. T. and L. N. equipments, but the "empty and load," "electro-pneumatic control" and "universal" equipments, because the pneumatic features embodied in the valve mechanisms and the results obtained were considered flatly impossible by all other air brake men.

Many of the qualifications of a successful air brake man cannot be acquired by practice or study. Chiefly among them is the ability to unfold a proposition in a manner than can be grasped by the hearers. In this accomplishment Mr. Turner is the past master.

The readers will pardon the apparent digression from the main issue, as we believe in credit to whom credit is due.

A number of humorous incidents in his railroad career were mentioned to illustrate some general attitudes toward the brake, how he was sometimes discharged for holding trains to repair brakes and for thus disobeying orders, but each time

T. W. DOW,
Vice-President Air Brake Association.

the final investigation resulted either in a promotion or an increase in pay.

While many of us are inclined to begin our air brake arguments at the brake cylinder, triple valve or brake shoe, Mr. Turner usually begins at the rail and sometimes long before it is placed on the ties.

The paper in question is an outline of the braking power problem and an explanation of why changed conditions and changes in rolling stock affect the efficiency of the brake.

The following remarks of Mr. Turner can be taken as his attitude toward air brake improvements, especially the last two sentences:

"The fact that we have a transportation condition with us is a sufficient reason for a review of some of the problems contained therein. Transportation of either people or commodities, once commenced, has the faculty of naturally both increasing its need and its quantity, the effect being continuous and accumulative, since it makes necessities of those things which without transportation would continue to be luxuries, even if they could be obtained at all.

"Again, it enables remote quarters of the world to be reached and exploited, and in our own country, what without it would be worthless, or rather undeveloped, vast areas to be made productive and contribute to the welfare and and comfort of man. This tends to scatter the population and materially increase it in sections which would otherwise be sparsely inhabited, and this again in turn tends to make further need of improvements in transportation facilities.

"Thus we have rapidly grown from very few means of facilities for communication or transportation into our present highly developed, and still developing, magnitude of both railroads and the equipment necessary for their operation.

"Among the problems that confront us are those of extension and betterment—extension into places which are as yet but inadequately served, and to others not yet developed, because not yet penetrated by that most wonderful and useful servant of the people—the railroad, and the improvement of those facilities already existing in many localities at present; for, obviously, the sensible mode and method where facilities already exist is to increase their efficiency or capacity until waste becomes an unknown quantity before extension should be considered. In other words, the higher the efficiency, everything considered, the greater will be the returns in both service and profit from a given investment."

The paper then takes up changes in conditions, the differences in foot pounds energy that must now be dealt with, how they are determined as an accurate basis and applied to braking problems, and the modern problems of break-in-two trains are clearly explained.

Improvements in brake appliances are enumerated both for freight and passenger service, and specific recommendations for train handling, inspection of draft gear and braking power are laid down.

The paper contains the formulaes upon which braking power calculations are based, and is illustrated with diagrams to make perfectly clear the technical portions, and will no doubt soon appear in the usual form of Westinghouse publications.

The concluding remarks of it are:

"The control of trains has become a much more complicated problem than heretofore, much knowledge of all the conditions involved is necessary, and the best talent available will be taxed to the limit to get the most economical efficiency,

and yet, strange as it may seem, these things are realized only by the few.

"The air brake has advanced in the past year or two from being considered chiefly a safety appliance that was required by law to be applied, to an absolute necessity in the handling of freight and passenger trains, and its operation must be properly understood to make it a dividend earning asset."

The third day's session was opened with a discussion of Mr. Farmer's paper on break-in-two of trains.

The paper is so well written that it is difficult to make any reference to any particular part of it, as Mr. Farmer has gathered together all of the factors entering into the problem of break-in-two of trains and interlocked them so closely that practically any recommendation or paragraph is in itself incomplete without the other references bearing upon it.

Altogether the tests made and the manner in which the results have been placed before the association leaves very little room for discussion.

The effects of various methods of brake manipulation are so clearly set forth and substantiated by the experiences of other members that the paper, the record of remarks made upon it and the references to and inspection of draft gear and track conditions should be in the hands of every railroad man who has even the most remote connection with train brake operation.

As the writer sees it, modern locomotives and trains have changed air brake conditions to such an extent that it is best for the air brake men who have had no experience or no instructions as to the brake operation on such trains, to forget all they have previously learned and begin again their study from an entirely different angle, the Westinghouse instructions and similar air brake publications included, as their recommendations were correct and covered the conditions existing at the date of their publication, but for present day service a different line of instruction must be adopted.

At the conclusion of the discussion of this paper a telegram from Mr. T. L. Burton was read in which he wished to leave the report on clasp type of foundation brake gear for passenger cars to remain before the association for another year, at which time he would have some additional information bearing upon the two shoes per wheel system.

A letter from Mr. R. C. Angur advised the president that on the subject of Friction and Wear on Brake Shoes, nothing of sufficient importance had been disclosed during the past year to warrant any addition to the report as submitted before the previous convention. Thus practically all of the three days' discussions were on the most important problems confronting the air brake man of today, that is, undesired quick action and break-in-two of trains.

As an illustration of the effects of undesired quick action or rough handling of trains we have a reproduction of a photograph of the damage to a car lot of player pianos damaged from one of those causes.

It was secured from the B. & O. R. R. Employees' Magazine, the freight charges on the shipment being $83.33, and the damage to lading being $1,916.67, not a very profitable business transaction for the railroad.

The first vice-president of one of the large Western railroads who is interested in the subject of "Safety First," and who appreciates the importance of the air brake enough to put aside his duties long enough to visit the convention hall during the second day's session, pointed out that the most rigid economy in railroad operation was now necessary.

He explained how the cost of labor and material had advanced until at the present time, taken from an average on all the roads in the country the revenue derived from hauling one ton of freight one mile was a trifle less than ¾ of 1 cent, a great deal of which he attributes to adverse legislation.

At the close of the third day's session Mr. Turner read Mr. S. W. Dudley's paper, entitled "Will the Triple Valve Operate as Intended?"

This paper resulted from some extensive experiments conducted jointly by the Westinghouse Air Brake Co., and the Pennsylvania R. R., and the particular object was to secure some additional information concerning triple valve operation, especially with different sized brake pipes and under other differences of conditions, particularly on the double P. M. equipment.

It is here that the shopman's knowledge appears very conspicuously as any shopman knows all about triple valve operation and construction, but apparently the brightest air brake men in the profession do not, and have recently spent considerable time and money in an effort to get some information along this line.

EFFECT OF UNDESIRED QUICK ACTION IN A CAR LOT OF PLAYER PIANOS.

Mr. Dudley covered the subject in his usual thorough manner, and several hundred results appear in diagrams and tables which involved thousands of individual tests, and the entire paper composes about one-half of the total printing in the advance copies.

While reading this paper Mr. Turner took the opportunity to state that the triple valve problem confronting the designer and manufacturer and presented their point of view.

There will be no printed record of those remarks, but those who purchase triple valves should have heard them. He intimated a great deal more than he actually said, but left us under the impres-

sion that under present conditions the work imposed and demanded in the construction of triple valves was about equivalent to approaching a locomotive builder and demanding an engine, the weight not to exceed 75 tons, that will haul a train of 3,000 tons ascending a 1½ per cent. grade at a speed of not less than 40 miles per hour.

The inferences were not in the nature of a series of excuses, but a very honest criticism of laxity in air brake maintenance.

The paper in itself is of a very technical nature, and has required an enormous amount of work to bring it to its present comprehensive form, and must be studied by the air brake man in order to be understood and appreciated.

The dast day's session consisted of the reading and discussions on the papers, "Steam Heat Drips—Their Relation to Wheel Sliding on Passenger Car Equipment," by Mr. C. W. Martin, and "Failed Air Hose," by Mr. T. W. Dow.

Mr. Martin called attention to the location of steam heat drips and how in many cases the condensation was permitted to reach the rail or car truck, and in cold weather freeze and result in wheel sliding. The paper is illustrated with photographic views of improper location and the attending results, and contains recommendations to cover the location of those drips and the disposition of the condensation.

On continuation of the subject of failed air hose, Mr. Dow reported that from what he could learn there had been no material improvement in hose that were being manufactured for air brake service, and that the bursting and blowing off of hose was still prevalent, that certain railroads are keeping a check on the failures from this cause, with the intention of bringing it to the attention of the M. C. B. Association, for in many cases this is the only logical place to apply for relief, as hose manufacturers take the stand that first quality air brake hose cannot be furnished at the common price now being paid for it.

This paper was followed by the review of the association's recommended practice, and the election of officers for the ensuing year.

The convention as a whole was a huge success, and the proceedings will contain more practical and useful information than has ever been derived from any previous convention, which is very gratifying, showing that the character of these meetings is constantly advancing with air brake improvements.

The members were delighted with the continued courtesy of the hotel management, the American Brake Co., and the railroads, in fact of every one with whom they came in contact, and the large attendance of the ladies added lustre and brilliancy to the occasion.

The ladies were entertained during sessions with excursions to various points of interest, visits to theaters and shopping districts, and Thursday P. M. the entire association was entertained on board a river steamboat which traveled up the river far enough to permit of an enjoyable time in dancing, music and a banquet on board.

Convention Notes.

Messrs. Otto Best and F. Von Bergen were with us. Dull moments eliminated.

The supply companies distributed the usual amount of advertising novelties, such as pencils, key rings, match safes, note books, etc.

The Westinghouse Air Brake Company distributed thousands of copies of their instruction pamphlets and standard publications. A large table was piled high with the various copies, notably among them being Mr. Turner's "Developments in Air Brakes for Railroads," "Brake Operation and Manipulation in General Freight Service," and "The Air Brake as Related to Progress in Locomotion." The members were cordially invited to take with them any number of copies they wished and it was necessary, on several occasions, to replenish the supply and late as Friday morning no one had carried away the table.

Several hundred copies of RAILWAY AND LOCOMOTIVE ENGINEERING for May were distributed in the convention hall.

A number of air brake instruction cars were stationed at the foot of Pine street, and were visited by the members.

Some of the instructors requested a large number of copies of this issue of RAILWAY AND LOCOMOTIVE ENGINEERING to be distributed from the car with a view of stimulating an added interest of their road and shop men. So far as possible their requests were granted.

We were agreeably surprised to find that on several roads entering St. Louis the engineers had organized schools of instruction in cars furnished by the respective companies, but that by a mutual agreement the school of instruction governed the movement of the car.

We were advised that the monthly issues of RAILWAY AND LOCOMOTIVE ENGINEERING were used as a text book in three of the cars and that all members of the school had free access to its pages. Gratifying but a doubtful proposition as to increasing the subscription list.

There was at least one B. & O. R. R. representative whose baggage, thanks to the W. A. B. Co. and other supply companies, was considerably heavier when leaving than upon arrival.

The H. W. Johns-Manville Co. introduced a very novel tool for applying packing leathers and their patent expander ring.

Through the courtesy of Mr. Adreon the members were conducted through the American Brake Co.'s extensive plant.

The annual ball was largely attended, every member regarding it his duty as well as pleasure to spend at least a portion of the evening in the ball room. The charm of the ladies and their beautiful costumes were delightful to the eye.

Mr. Carey, general superintendent of transportation, who addressed the convention on Wednesday, was appointed first vice-president of the Missouri Pacific Lines. Recalling his remarks and style of address we believe that this promotion is the result of sheer ability.

We were pleased to note the presence of Mr. and Mrs. J. R. Alexander, after an absence of two years. Mr. Alexander occupied the chair during a portion of Thursday's session.

St. Louis, with its magnificent hotels, notably the Planters and the Jefferson, is an ideal convention city.

In the midst of elaborate entertainments the attitude of the conventions always seems to be business first and the members refuse to sanction adjournment so long as air brake information is being derived from any subject, as long as this continues there is no question as to the future success of the association.

The present measure of success and constant advancement is largely due to the unfailing attendance of Mr. Turner, who puts aside his duties and reviews the air brake events of the past year.

Mr Turner informs us that he is still a railroad air brake man at heart and looks forward with a pleasurable longing for these meetings.

We believe that in these conventions he forgets everything but air brakes and enters the discussions with the zeal and fervor of a new member.

LIST OF EXHIBITORS.

Adreon Manufacturing Co., American Brake Co., American Steel Foundries, Ashton Valve Co., Crandall Packing Co., Crane Co., The Detroit Lubricator Co., Joseph Dixon Crucible Co., Emery Pneumatic Lubricator Co., Garlock Packing Co., Gold Car Heating Co., Greene Tweed & Co., H. W. Johns-Manville Co., The Leslie Co., Marvin Manufacturing Co., McQuay-Norris Manufacturing Co., Nathan Manufacturing Co., New York Air Brake Co., New York & New Jersey Lubricant Co., Pyle National Electric Headlight Co., Standard Heat & Ventilation Co., Universal Flexible Packing Co., The United States Metallic Packing Co., Westinghouse Air Brake Co., Guilford L. Wood.

A commercial traveler on arriving at a wayside station remarked to the chief official: "I observe your service has improved." "Can't see it," replied the station master stoically. "Oh! I can," said the "commercial," "your trains are able to whistle without stopping now."

Electrical Department

Automatic Tripping Device.

One of the most important devices, and one in which all railroad men should be interested is the automatic trip. Many serious accidents have occurred, due to the engineer running by a danger signal. These accidents will continue, for man is not infallible, unless some means are provided for having the air brakes set automatically if the train passes into the danger block. Money saved is money earned, and there is no better way to help increase the earnings of a railroad than to cut down the accidents which many times are very costly.

The first case we know of where this automatic setting of the brakes was accomplished, is in the New York Subway. A handle similar to that on a cut out cock, although heavier, is so placed on the trucks of the cars, that same hits against a projection, placed alongside of the track and controlled by the signal, if the signal is at danger. The striking of this handle against the projection causes an air valve to open, releasing the air from the train line and applying the brakes in emergency.

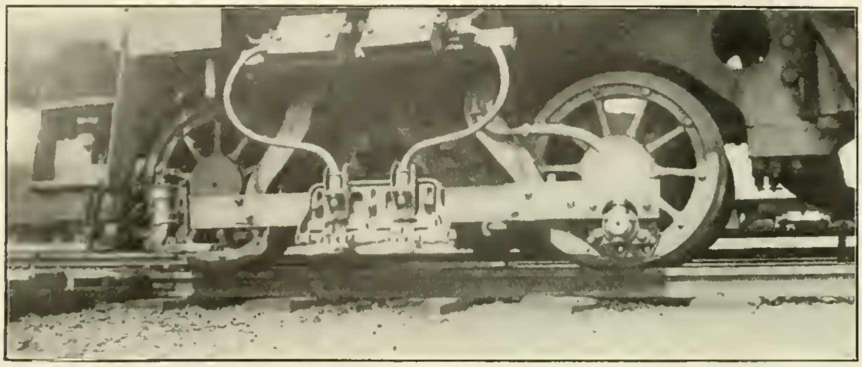


FIG. 1. THIRD RAIL SHOE BEAM. ELECTRIC LOCOMOTIVE.

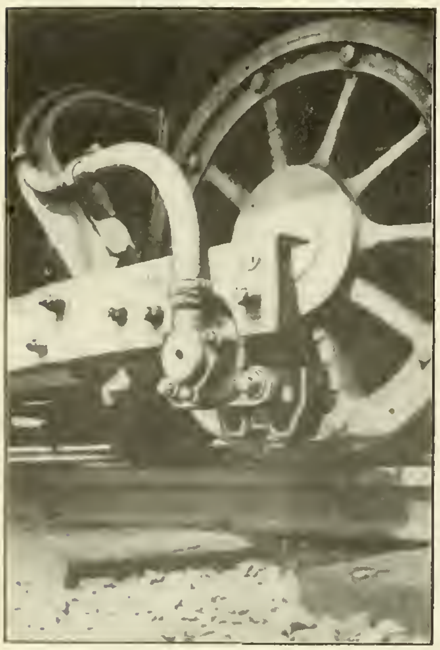


FIG. 2. VIEW OF AIR VALVE SHOWING V-SHAPED CASTINGS.

When the Pennsylvania Railroad built the tunnels under the Hudson and East Rivers and located its station on Manhattan Island, the heart of New York City, everything for the safety of its passengers was considered. The latest and best in signals was installed and moreover it was decided to use the automatic trip to reduce to a minimum all possible chances of a wreck in the tunnels.

A trip similar to that used in the subway was contemplated, but tests showed that it was almost impossible to design a trip of this form which could stand up to the hard blows which would result with the heavy electric trains running at over sixty miles per hour. Moreover, the projecting handle could be hit easily by flying ballast or any obstructions along the track, causing an unnecessary delay to the train.

Many schemes were tried, before the present arrangement was reached, which has worked out extremely satisfactorily. The present arrangement is absolutely positive and the parts are light, not causing sluggish operation, which would be the result if heavy parts were used. It is impossible for obstructions to operate the valve as same is protected by guards as will be explained further on.

The location of the air valve, the location of the trip and construction is shown by the illustrations. Fig. 1 shows the location of the air valve on the electric locomotives. On each of the bogie trucks, one at each end of the locomotive, are placed what are known as third rail shoe beams. These beams are carried on bracket arms bolted to the truck. On the beams, which are wooden, are placed the third rail shoes, used to collect the electric current from the third rail, for operating the main motors. The emergency air valve is shown mounted on this same beam at the extreme right.

A larger view of this valve is shown by Fig. 2. The train line air pressure is brought along one of the bracket arms, holding up the beam and is connected to the valve by a rubber air hose. An examination of the mechanism shows two V shaped castings with a block between them, located below and just back of the front part of the air valve where the air pressure is admitted. The block between the V castings is very light and can be raised vertically. At a certain height this block will engage with a stop and any further travel will cause the valve to open, applying the brakes.

The trip placed alongside of the track is of peculiar shape. When the signal is in the danger position this trip stands in the position shown by Fig. 3. The V shaped castings on the shoe beam, Fig. 2, will hit the middle tooth of the trip, rotating same so that the outside tooth will pass between the two V shaped castings, pushing the block up and opening the air valve, stopping the train. Springs are placed on either side so that the trip is simply pressed down, without damage after the valve has been opened, as the engine passes by.

FIG. 3. TRIP AT DANGER POSITION.

The trip is mounted on the square rod, which is rotated, putting the trip in either the danger or the clear position,

by means of an air cylinder protected by the iron cover shown between the tracks. The valve admitting air to this cylinder is interlocked with the signal which is

FIG. 4. TRIP AT CLEAR POSITION.

located near by. Fig. 4 shows the trip in the clear position. All parts are low enough so that the mechanism on the show beam on the locomotive passes by without interference.

One of these trips is located on each side of the track and an air valve is located on each side of the locomotive.

The Electric Tractor.

Much interest is being shown in the electric tractor recently turned ouf of the Pennsylvania Railroad Company's Juniata shops. It can be classed as the most powerful automobile ever built, for it is intended to replace string teams of horses used for hauling cars over railroad tracks in city streets for delivery to local industries.

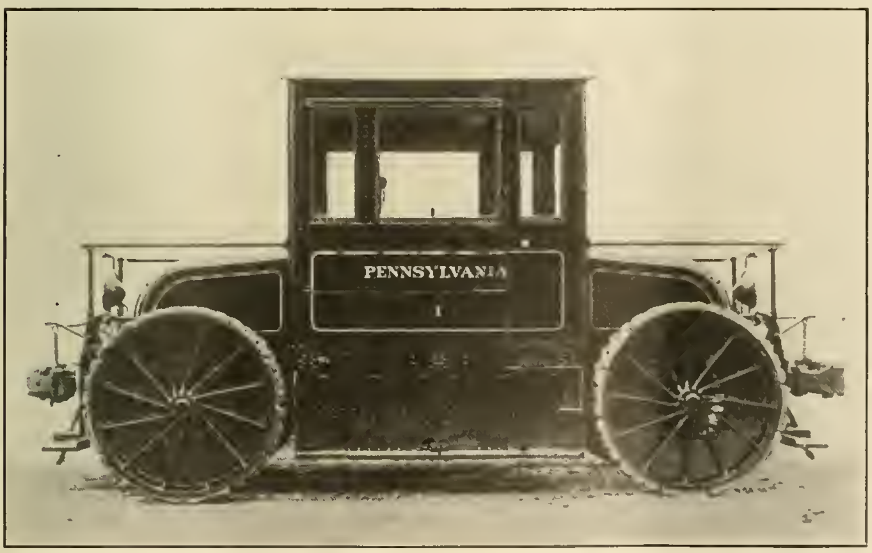
Some of the most remarkable features of this tractor are that it drives, steers, and brakes, on all four wheels. The development of these features was made necessary on account of the short radius curves, around which the tractor would be required to operate and the necessity of driving all four wheels in order to secure the necessary tractive effort.

As the appearance indicates, storage batteries of the Edison type, weighing 4,350 pounds are used, which supply power to two electric motors of approximately 20 horsepower each. These motors are geared through herringbone gears, used for their strength and quiet running qualities.

The four-wheel steering arrangement allows the tractor to turn in a circle of 20 feet radius—the trailing wheels tracking with the forward wheels. On each side of the cab. within easy reach of the operator, there is a brake valve, that controls the operation of the air brake apparatus, of the automatic type, air being supplied to the main reservoir by a motor driven air compressor. The application of air acutates a system of equalizing levers, operating the internal expanding brakes carried by the wheels. Air brake hose couplings allow the use of air on the cars to be shifted.

The normal drawbar pull of the tractor is 8,000 lbs. On a trial test, a locomotive of the Class R type rated at 21,500 drawbar pull, with throttle wide open, was pulled backwards several feet by the tractor. Following are some of the principal dimensions and characteristics:

Length over couplers, 23 ft.; wheel base, 12½ feet; diameter of wheels over tires, 5 ft.; tread of wheels, 7 ft.; width of tires, 12 ins.; width over all, 8 ft. 4 ins.; height over all, 11 ft. 3 ins.; weight, 28,850 lbs.; speed (normal) 6 miles per hour.



ELECTRIC TRACTOR. PENNSYLVANIA RAILROAD.

The Transformer.

The transformer used so commonly at the present day in connection with electrical energy is very simple in construction. One can hardly pass along the streets without noticing them either on the poles of the lighting company or on the houses using electric power for lights.

The principle of the transformer was discovered by Faraday. Among some of his earliest experiments he took an iron ring about 8 inches in diameter and wound upon it two insulated coils of wire, on opposite quarters, each of many turns. He found if one coil was connected to a battery circuit, that when the current was turned on or off a current was generated in the other coil, although the two were in no way connected together.

The current in the second coil was an induced current and was formed by the change in the lines of force passing through the coil. What do we mean by the lines of force. Namely, this: The battery current tends to magnetize the iron ring and this magnetism or lines of force circulates in the iron. After the current is turned onto the coil it takes a certain fraction of a second for it to reach a full constant value due to the lines of force rising from zero to full value, depending on the diameter of the iron and the amount of current in the coil. Also when the current is turned off it takes a certain time for the magnetism to die down to zero. It is this change of magnetism in the iron that induces the current in the second coil. While the current is constant in the first coil no current will be induced in the second coil, and it is this fact which explains why transformers are used with alternating currents only and not with direct currents. The latter are constant in value, whereas the former, as the name signifies, changes or alternates from zero to maximum value and back to zero again all in a fraction of a second. Therefore with alternating current connected to the first coil there would be a continual change in the magnetism or lines of force and current would be induced in the second coil.

The transformer of today is as simple in principle as the above explanation. Of course the iron ring has been replaced by a more elaborate iron core and the few turns of wire replaced by a more economical and efficient winding, but we have the iron and the two windings which are in no way connected.

Another principle is that the ratio of the number of turns around the iron of each coil determines the ratio of the current and voltage. For instance, if we say one coil has 100 turns and the other 200 turns, then if an electric circuit of 50 volts and 75 amperes is connected to the first coil we will have 100 volts on the second coil and 37½ amperes. That is, the voltage is directly as the number of turns and the current inversely as the number of turns.

The transformer is an especially important piece of electrical apparatus, for by its use it is possible to send out electric power at high voltage, up to 110,000 volts and then step or transform it down.

Mallet Compound Locomotives for the Norfolk and Western

Extensive use of Mallet locomotives has been made by the Norfolk & Western Railway in connection with its operating policy in the development of heavier train units. In May, 1910, this road put into service ten Mallet locomotives, five of which were of the 0-8-8-0 type and five of the 2-8-8-2 type. These locomotives have demonstrated the possibilities of increasing efficiency and economy of operation by means of the great savings involved by increased train tonnage.

The development of the Mallet locomotive in the past two years has shown that with the addition of trucks increased boiler capacity may be obtained, thereby greatly increasing the sustained capacity of the locomotive, which is especially important in connection with road as distinguished from pusher service.

The Norfolk & Western officials, cooperating with the builders, after carefully considering this development in the light of the experience of this and other roads, produced the 2-6-6-2 type Mallets herewith illustrated. Forty of these Mallets were delivered by the American Locomotive Company during 1912 and forty more are now under order. It is interesting to note the extension of the use of Mallet locomotives in road service on this road, where conditions are especially favorable.

In ordering this equipment, it was the purpose of the Norfolk & Western officials, not so much to dispense with the pusher service, as to increase the maximum train load over the division.

On the Pocahontas division, between Eckman and Bluefield, five 0-8-8-0 type, five 2-8-8-2 type, and fifteen of the new 2-6-6-2 type Mallets are being operated in both head end and pusher service.

On the Radford division, between Bluefield and Roanoke, five of the new 2-6-6-2 type Mallets are being operated in road service. This division is 105 miles long and includes a forty mile grade of 0.4 per cent. and a ten mile grade of 1.0 per cent. With the help of a pusher service on this ten mile 1.0 per cent. grade these Mallets have increased the train tonnage from 2,800 to 4,000 tons.

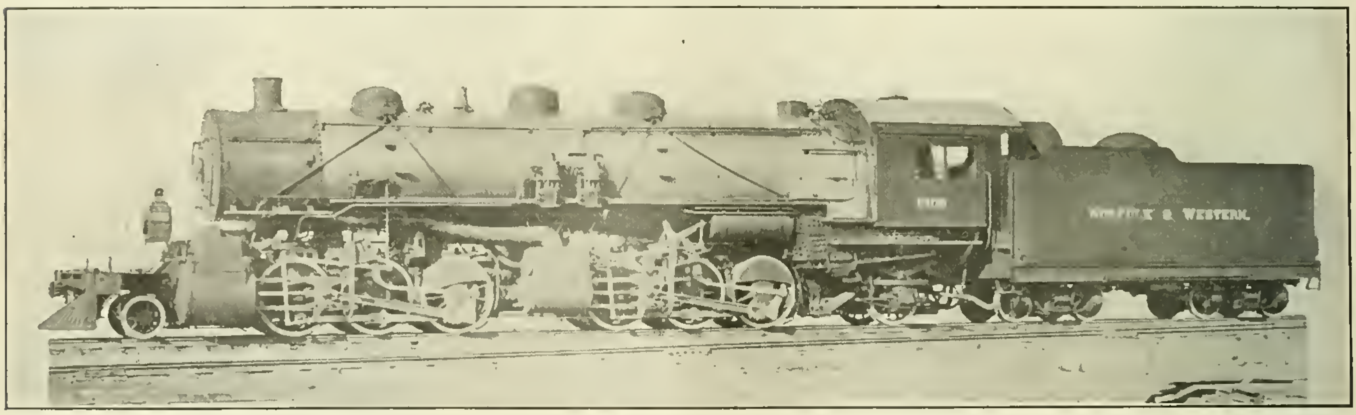
The remaining twenty of the new 2-6-6-2 type Mallets are being operated in road service on the west end of the Norfolk division, between Roanoke and Crewe, a distance of 130 miles. On account of especially favorable terminal as well as road facilities, these Mallets are doing their best work on this division.

Before the installation of these Mallets the tonnage on this division was handled by 4-8-0 type locomotives, having a total weight of 260,000 pounds, 220,000 pounds being on drivers, and having a tractive effort of 52,500 pounds. Leaving Roanoke with a 3,500 ton train, which was the rating, two of these 4-8-0 type engines were at the head end. At Bonsack a 4-8-0 type engine was put behind the train to push it to Blue Ridge. At Blue Ridge the helper was cut out and returned light to Bonsack to await another eastbound train. From Blue Ridge the 3,500 ton train, with the two engines in the lead, proceeded to Phoebe. At Phoebe the lead engine was cut out and the train and the one engine continued to Crewe. The one 4-8-0 type engine readily hauled the 3,500 ton train over this portion of the road, except at Farmville it was assisted over the short grade by another 4-8-0 type engine.

At present, starting out from Roanoke with a 5,000 ton train, one of these Mallets is in the lead, double-headed by a 4-8-0 type locomotive. These two engines pull the train from Roanoke to Bonsack, a distance of 9 miles made up of broken grades. At Bonsack another of these Mallets is put behind the train and pushes it to Blue Ridge, a distance of 6 miles. From Bonsack to Blue Ridge there is a ruling grade of 1.2 per cent. At Blue Ridge the pusher cuts out and returns to Bonsack light. From Blue Ridge the two engines in the lead haul the train to Phoebe, a distance of 56 miles from Blue Ridge. This 56 miles is made up of broken grades but includes a 0.5 per cent. grade 8 miles long. At Phoebe the lead 4-8-0 type engine is cut off and waits for a westbound empty train, helping as a double-header back to Roanoke. From Phoebe, therefore, the one Mallet or through engine hauls the train to Crewe, a distance of 59 miles of broken grade, with the exception of the 16 miles from Farmville to Burkeville. This 16 miles is made up of a continuous grade of 0.45 per cent. and a 4-8-0 type engine is used here as a pusher.

This means that on the Radford division train loads have been increased 43 per cent. and on the Roanoke division 43 per cent. Fifty-seven locomotives have been supplanted by these forty Mallets, and a reduction of 25 per cent. has been effected in the number of freight trains operated over the divisions.

Details include the latest knowledge in locomotive engineering, improvements in design and the application of fuel saving devices. One of the principal features of interest lies in the boiler construction. The boiler incorporates a combustion chamber 78 inches long. This allows the firebox to be brought back of the rear driving wheels, thereby making it possible to obtain a good depth of throat sheet, without excessively increasing the length of tubes. As a result a throat sheet 18-1/16 inches deep is obtained with a tube length of 24 feet. High temperature superheat, fire brick arch, together with a combustion chamber 78 inches long, should give great economy in operation. Fifteen engines were equipped with Walschaert and twenty-five with Baker gear. All these engines have Street stokers. Reversing is effected by means of the builders' hydro-pneumatic reversing gear. This reversing gear not only renders the operation of the engine easier than that of the ordinary simple engine, but allows the use of steam with full throttle and cut off arranged at the most economical point. The builders' latest style of out-



2-6-6-2 TYPE MALLET COMPOUND LOCOMOTIVES FOR THE NORFOLK & WESTERN RAILWAY.
W. H. Lewis, Supt, Motive Power. American Locomotive Company, Builders.

side bearing trailing truck was applied. This truck was also used on the Chesapeake & Ohio Mallets and is similar in design to that successfully applied to a number of recent Pacific type locomotives. With the exception of the case above mentioned, the type of leading and trailing trucks applied to Mallet locomotives by the American Locomotive Company has been the radial swinging bolster type with journals inside of wheels. The outside bearing truck used gives a wider supporting base and tends to add to the stability of the locomotive.

American Locomotive Company's system of compounding, including intercepting valve, was also applied. With this system of compounding, it is possible to increase the power of the engine about 20 per cent. at critical moments, by admitting live steam to all cylinders. At the same time, the intercepting valve so controls the pressure of the live steam entering the receiver pipe, that equal work is done in all four cylinders.

Outside of the features above mentioned, the design in general follows the builders' standard practice.

The following dimensions, weights and ratios of the new 2-6-6-2 type locomotives might be interesting:

Type of locomotive, 2-6-6-2; service, freight; cylinders, 22 and 35 x 32 ins.; tractive power, working compound, 72,800.

Boiler—Type, conical connected; working pressure, 200 lbs.; diameter, F. 83⅞ ins.; B. 96 ins.

Fire Box—Length, 108⅛ ins.; width, 96⅛ ins.; grate area, 72.2 sq. ft.; fuel, soft coal; tubes, number, 243, 2¼ ins.; 36, 5½ ins.; length, 24 ft. 0 ins.; combustion chamber, 78 ins.

Heating Surface—Firebox, 343 sq. ft.; tubes, 4,655 sq. ft.; arch tubes, 25.4 sq. ft.; total, 5,023.4 sq. ft.; superheater, 995 sq. ft.

Driving Wheels—Diameter, 56 ins.; journals, 10 x 12 ins.

Truck Wheels—Diameter, front, 30 ins.; journals, 6 x 10 ins.; diameter, back, 44 ins.; journals, 8 x 14 ins.

Wheel Base—Driving, 10 ft. 0 ins.; rigid, 10 ft. 0 ins.; total engine, 48 ft. 10 ins.; total engine and tender, 79 ft. 3½ ins.

Weight on driving wheels, 337,300 lbs.; total engine, 405,000 lbs.; total engine and tender, 563,000 lbs.

Tender Wheels—Diameter, 33 ins.; journals, 5½ x 10 ins

Capacity—Water, gallons, 9,000.

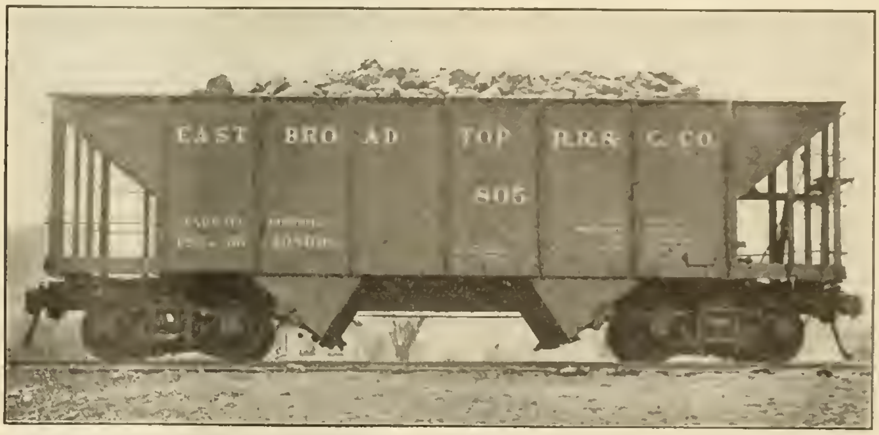
Capacity—Coal, tons, 14.

Among the great engineering enterprises contemplated is the construction of a ship canal connecting the Firths of Forth and Clyde in Scotland. It will be a stupendous undertaking and has been promised the financial support of the British government.

Narrow Gauge Steel Hopper Cars

The Pressed Steel Car Company recently turned out at its Pittsburgh plant a lot of narrow gauge hopper cars for the East Broad Top Railroad & Coal Company for operation between Mt. Union, Pa., and Orbissonia, Pa., these being the only all steel narrow gauge hopper cars in use on any of the railroads of the United States. These cars are for carrying coal from the mines to the main line of the Pennsylvania Railroad at Mt. Union and they have proven to be superior to the wooden cars which have previously been used on account of the greater carrying capacity and decreased cost of maintenance.

The cars are 60,000 lbs. capacity, built for 3 ft. gauge track, and weight about 20,700 lbs. each; distributed 12,000 lbs. to the body and 8,700 lbs. to the trucks. Based on the average amount of coal being loaded in these cars the ratio of paying freight to total weight of car when loaded is 73½ per cent.



NARROW GAUGE STEEL HOPPER CARS FOR THE EAST BROAD TOP RAILROAD & COAL COMPANY.

The general dimensions of the car are as follows:

Length inside, 25 ft. 7 ins.; width inside, 7 ft. 6 ins.; width over side stakes, 8 ft. ⅜ in.; length over striking plates, 27 ft. 4¾ ins.; height from rail to underface of body side bearings, 1 ft. 10½ ins.; height from rail to center of coupler, 2 ft. 2 ins.; distance center to center of trucks, 18 ft. 4 ins.; height from rail to top of body, 8 ft. 6 ins.; height from rail to top of brake mast, 8 ft. 11½ ins.; length of drop doors in clear, 3 ft. 1⅞ ins.; width of drop doors in clear, 2 ft. 6 ins.

The various items of specialties with which the cars are equipped are as follows:

Air Brakes, Westinghouse Schd. KD-812; Side Bearings, Pressed Steel Body and Mall. Iron Truck; Draft Rigging, Miner; Trucks, Arch Bar Type; Axles, O. H. S. with 4 x 7 in. journals; Spring Planks, 12 in. Pressed Channel, 5/16 in. thick; Truck Bolsters, Pressed Steel Bathtub Type; Brake Beams, Pressed Steel Channel Type; Brake Shoes, Spear & Miller steel back; Journal Bearings, per P. S. C. Co. Spec. J-2-b; Journal Wedges, Mall. Iron.

DETAILS OF BODY CONSTRUCTION.

The body bolsters are built integral with underframe and each bolster consists of one ¼ in. O. H. S. web plate with malleable iron center brace and reinforced at top with a flange and the floor of car, and at the bottom with a 12 x ⅜ in. plate and 3 x 3 x 5/16 in. rolled angles. There is one cross bearer located across center of car made of angles and 3/16 in. plates. The car is equipped with four doors located near center of car and made of 3/16 in. pressed steel reinforced by flanges and channels. The doors are operated by the "Lind" door gear, the operating shaft being 2 ins. in diameter. The four diagonal braces extending between bolsters and end sills are made of 3½ x 3½ x ¼ in. rolled angles. The end sheets are ¼ in. thick, reinforced at top and bottom with a flange; the floor sheets are 3/16 in. thick and the side sheets 3/16 in. thick, reinforced at top by a 3 x 3 x 3/16 in. rolled angle, and at bottom by a 3 x 3 x ¼ in. angle and vertically with seven stakes of 3/16 in. pressed steel. The two center sills are made of 10 in. 20 lb. channels and extend between bolsters, being tied together and reinforced at top with a 15½ x ¼ in. plate, 3 ft. 9½ in. long over each bolster. The draft sills are also 10 in. 20 lb. channels extending from end of car to about 2 ft. back of bolster. The end sills are 6 in. 8 lb. channels and sub end sills are ¼ in. pressed steel, reinforced at top and bottom with flanges and at coupler opening with O. H. S. striking plate to which is bolted the coupler carrier made of 3½ x 3½ x ⅜ in. rolled angle. The side sills are 6 in. 8 lb. channel extending from bolster to end sill.

Items of Personal Interest

Mr. M. H. Farrell has been appointed shop foreman on the Western Alleghany at Kayler, Pa.

Mr. H. E. Myers has been appointed shop superintendent of the Lehigh Valley shops at Packerton, Pa.

Mr. L. E. Wingfield has been appointed master mechanic of the Arkansas Central with office at Pan's, Ark.

Mr. Wm. H. Sloat has been appointed master mechanic on the Dayton & Union, with office at Dayton, Ohio.

Mr. W. P. Davis has been appointed master mechanic on the New York Central Lines at Brewster, N. Y.

Mr. R. C. Ross has been appointed acting master mechanic on the Vera Cruz Terminal at Vera Cruz, V. C.

Mr. E. Fuller has been appointed master mechanic on the Augusta Southern, with office at Charleston, S. C.

Mr. Joseph Pollock has been appointed master mechanic on the Jefferson & Northwestern at Jefferson, Tex.

Mr. P. Ryan has been appointed roundhouse foreman on the Intercolonial Railway of Canada at Chaudiere Jct., Que.

Mr. F. O. Peeples has been appointed master mechanic of the Ohio River & Western, with office at Zanesville, Ohio.

Mr. S. R. Mathes has been appointed general foreman on the Atlanta, Birmingham & Atlantic shops at Manchester, Ga.

Mr. J. J. Romkine has been appointed locomotive foreman of the Inverness Railway & Coal Company at Inverness, N. S.

Mr. J. H. Green has been appointed master mechanic of the Halifax & Southwestern, with office at Bridgewater, N. S.

Mr. R. A. Bellingham has been appointed master mechanic of the Apalachicola Northern, with office at Port St. Joe, Fla.

Mr. T. L. Carr has been appointed road foreman of engines of the Pennsylvania Lines West, with office at Louisville, Ky.

Mr. J. A. Read has been appointed general foreman of the locomotive department on the Georgia Southern & Florida, at Macon, Ga.

Mr. H. R. Warnock has been promoted to the position of master mechanic of the Monongahela, with office at South Brownsville, Pa.

Mr. P. J. Clark has been appointed superintendent of motive power of the Georgia, Florida & Alabama, with office at Bainbridge, Ga.

Mr. John Sutherland has been appointed master mechanic of the Iowa & Illinois at Clinton, Iowa. He succeeds Mr. J. F. Greenleaf.

Mr. J. F. Ashworth has been appointed master mechanic of the Tennessee Valley, with office at Oneida, Tenn. He succeeds Mr. G. F. Whitlock.

Mr. Charles Boertman has been appointed superintendent of the Pere Marquette shops at Saginaw, Mich. He succeeds Mr. George Hilferink.

Mr. C. E. Magee has been appointed master mechanic of the Gulf & Sabine River, with office at Fullerton, La. He succeeds Mr. C. T. Harrop.

Mr. F. A. Hussey has been appointed road foreman of engines of the Boston division of the Boston & Albany, with office at Beacon Park, Mass.

Mr. J. N. Weaver has been appointed road foreman of engines on the Baltimore & Ohio, with office at New Castle Jct. (P. O. Mahmintocon), Pa.

Mr. T. H. McLeod has been appointed master mechanic of the Canadian Northern, with office at Parry Sound, Ont. He succeeds Mr. C. L. Webster.

Mr. Herbert Reid, formerly night foreman of Winnipeg shops of the Canadian Pacific Railway, has been appointed locomotive foreman at St. Ignace, Mich.

Mr. J. E. McLean has been appointed master mechanic of the Kansas City Southern, with office at Pittsburg, Kan. He succeeds Mr. G. F. Wieseckel.

Mr. J. R. Edwards has been appointed general inspector of motor cars on the Lehigh Valley. He will report to the Engineers' office at Bethlehem, Pa.

Mr. George H. Roberts, formerly shop foreman at the Long Island shops, has accepted the position of shop foreman on the Lehigh Valley at Cortland, N. Y.

Mr. Howard P. Porter has been appointed superintendent of motive power and equipment of the East Jordan & Southern, with office at East Jordan, Mich.

Mr. William H. Dyer has been appointed master mechanic of the Georgia & Florida Ry., with headquarters at Douglas, Ga., succeeding Mr. E. C. Hause, assigned to other duties.

Mr. G. F. Wieseckel has been appointed master mechanic of the middle and eastern divisions of the Western Maryland railway, succeeding Mr. W. J. Bingley, assigned to other duties.

Mr. G. H. Matthews has been appointed foreman of shops on the Chicago & North Western at Green Bay, Wis., and Mr. W. P. Ramer, foreman of shops on the same road at Tracy, Minn.

Mr. A. C. Breisch has been appointed master mechanic on the Chicago, Rock Island & Pacific at Armourdale, Kans., and Mr. J. C. Rhodes has been appointed to a similar position on the same road at Estherville, Ia.

Mr. C. L. Bunch has been appointed general foreman on the Southern at Spencer, N. C.; Mr. Wm. B. Skipworth, general foreman at Columbus, Ga., and Mr. H. J. Heilig, road foreman of engines at Greensboro, N. C., all on the Southern Railway.

Mr. Chas. R. Westcott has been elected as secretary and treasurer of the M. C. B. Company. Mr. Westcott is a railroad man of long experience, and has been connected in an official capacity with the Erie, Southern, Illinois Central, and other railroads, and is a high authority in railway specialties.

Mr. Louis Gaul has been appointed locomotive foreman on the Great Northern at Delta, Wash.; Mr. J. P. Murtinger, locomotive foreman at Casselton, S. D.; Mr. Robert Smith, locomotive foreman at Leavenworth, Wash.; Mr. Ralph Yeaton, locomotive foreman at Garretson, S. D., and Mr. H. E. Woodward, car foreman at Havre, Mont., all on the Great Northern.

Mr. Charles A. Lindstrum, formerly chief engineer of the Pressed Steel Car Company, has been appointed assistant to the president, with office in the Farmers' Bank Building, Pittsburgh, Pa. Mr. B. D. Lockwood has been appointed chief engineer. Mr. J. F. Streib has been appointed assistant chief engineer, and Mr. Felix Koch has been appointed mechanical engineer with the same company.

Mr. B. L. Davis has been appointed general foreman on the Chesapeake & Ohio at Peru, Ind.; Mr. C. C. Gigley, general foreman at Summitt, Ohio; Mr. W. R. Noli, general foreman at Cane Fork, W. Va.; Mr. Jos. Pack, general foreman at H. Y. Tower, Ind.; Mr. W. L. Wilson, general foreman at Peru, Ind.; Mr. J. B. Carter, foreman of the car department at Huntington, W. Va.; Mr. D. T. Evans, road foreman of engines at Covington, Ky., and Mr. J. W. Enbroek, road foreman of engines at Cane Fork, W. Va., all on the Chesapeake & Ohio.

Mr. Robert W. Bell has been appointed general superintendent of motive power of the Illinois Central, with headquarters

at Chicago, Ill. He succeeds Mr. Morgan K. Barnum, resigned. Mr. Joseph H. Nash has been appointed superintendent of motive power, on the same road, on the lines north of the Ohio river, and Mr. Frank B. Barclay has been appointed superintendent of motive power on the same road on the lines south of the Ohio river. Mr. Nash's headquarters are at Chicago, and Mr. Barclay's at Memphis, Tenn. Messrs. Bell and Barclay are also appointed to similar positions on the the Yazoo & Mississippi Valley.

Mr. C. A. Seley, the celebrated mechanical engineer of the Chicago, Rock Island & Pacific, has resigned and entered a manufacturing business. Mr. Seley has been regarded as among the ablest mechanical engineers in the country, and it has long been to us a mystery why he was not called to a higher position, for which he was eminently fitted. He has taken a lead in the technical associations and has been for several years a member of the Executive Committee of the Railway Master Mechanics' Association, his election to that honor having been made by men well able to appreciate his abilities. Mr. Seley was at one time a favorite contributor to RAILWAY AND LOCOMOTIVE ENGINEERING and our readers regretted very much when pressing professional business deprived our pages of his, Mr. Seley's, interesting articles.

Mr. J. W. G. Brewer, formerly superintendent of shops of the Baltimore & Ohio, at Mount Clare, has been promoted to assistant district superintendent of motive power, with office at Baltimore, Md. Mr. P. Coniff, formerly master mechanic at Cumberland, succeeds Mr. Brewer as superintendent of shops at Mount Clare. Mr. F. R. Stewart, formerly master mechanic of the Riverside shops, Baltimore, has been transferred to Cumberland, succeeding Mr. Coniff. Mr. J. Kirkpatrick, formerly master mechanic at Newark, Ohio, has succeeded Mr. Stewart as master mechanic at Riverside shops. Mr. J. F. Bowden, formerly master mechanic at Garrett, Ind., has succeeded Mr. Kirkpatrick as master mechanic at Newark, Ohio. Mr. F. W. Rhuark, formerly master mechanic at Lorain, Ohio, has succeeded Mr. Bowden as master mechanic at Garrett, Ind., and Mr. J. A. Anderson, formerly general foreman at Lorain, Ohio, has been promoted to master mechanic at the same place, succeeding Mr. Rhuark.

Mr. David F. Crawford, the president of the American Railway Master Mechanics' Association, joined the organization in 1900 and has been noted as a hard working member. Mr. Crawford has gone through a remarkably fine training for a high position in railroad service. He was educated at the Pennsylvania Military Academy, then went through the apprentice course at Altoona. His first promotion was to be inspector of the tests department of the Pennsylvania Railroad, then assistant master mechanic, which led him to the position of assistant superintendent of motive power; finally superintendent of motive power of the Pennsylvania lines west of Pittsburgh, the place he now fills.

D. F. CRAWFORD,
President, M. M. Association.

Mr. C. E. Fuller, the president of the Master Car Builders' Association, began his railroad career as draftsman with the Vandalia in 1880. In 1889 he was appointed general foreman of the Hornell shops on the Erie. In 1890 he was made master mechanic of the New York division of the Erie. In 1892 he was appointed superintendent of motive power of the Central Vermont, with office at St. Albans, Vt. He returned to the Erie in 1901, as assistant mechanical superintendent. In 1903 he was appointed superintendent of motive power of the Chicago & Alton, and in 1908 he entered the service of the Union Pacific, and after serving for some time as superintendent of motive power, he was appointed assistant general manager, which position he still holds.

C. E. FULLER.
President, M. C. B. Association.

Pennsylvania Veterans Meet and Rejoice.

There is a great deal of social spirit among the older employees of the Pennsylvania Railroad, as the feeling is nurtured by the Veterans Employees' Association which requires twenty-one years of continuous service to entitle a person to membership.

This association of gray beards held a reunion in Pittsburgh, which consisted of an outing and a banquet at which R. J. Murray, superintendent of the Pittsburgh division, presided. A curious calculation was made that the service of the members in attendance represented 15,750 years. That weight of years did not, however, dampen the hilarity of the meeting.

Chairman Morrow said that tests of the efficiency of Pennsylvania Railroad employees showed that 99 per cent. of them represented perfect performances. Addresses were also delivered by General Superintendent O'Donnel, George C. Wilson, of Pittsburgh, general counsel for the Veterans' association; Division Freight Agent S. L. Seymour, of Pittsburgh; J. D. Hicks, of Altoona, who started railroading as a clerk in 1863 when Andrew Carnegie was in the service of the road. Another veteran who spoke was William Storey, of Johnstown. He is now one of the road's attorneys. He formerly was an operator.

When the banquet came to an end the company had a special train which went as far as Altoona, dropping the members off at their respective stations.

Obituary.

HENRY SCHLACKS.

The death is announced of Mr. Henry Schlacks, formerly superintendent of machinery of the Denver & Rio Grande. Mr. Schlacks was a native of Rhine Province, Germany, and came to America at an early age and served an apprenticeship as a machinist at the Welden shops of the Illinois Central. He occupied various official positions on the Chicago, Rock Island & Pacific, and latterly returned to the Illinois Central, and from 1882 to 1893 he was superintendent of machinery of that road. He accepted the position of superintendent of machinery of the Denver & Rio Grande in 1893, and remained in that position about ten years, when he resigned. He died in Chicago on May 16, in the 73d year of his age.

RAILROAD NOTES.

The Cuba Central is said to be in the market for 24,000 tons of rails.

The Baltimore & Ohio recently placed an order for 10,000 kegs of spikes.

The Harriman Lines have ordered 201 passenger cars from the Pullman Co.

The Atchison, Topeka & Santa Fe is said to have ordered 15,000 tons of rails.

The Charlotte Harbor & Northern is reported in the market for 35 phosphate cars.

The Vandalia has ordered 4 Pacific type locomotives from the American Locomotive Co.

The Havana Central has ordered 50 gondola cars from the Pressed Steel Car Co.

The Baltimore & Ohio has ordered 1,300 tons of rails from the Maryland Steel Co.

The Baltimore & Ohio, it is said, has ordered 500 hopper cars from the Cambria Steel Co.

The Grand Trunk is said to have ordered 3,000 cars from the Canadian Car & Foundry Co.

The Southern Pacific has ordered 5 mikado locomotives from the Baldwin Locomotive Works.

The Delaware & Hudson, it is reported, will erect several new shop buildings at Oneonta, N. Y.

The Erie is said to be in the market for 3,000 box cars, 1,500 hopper cars and 500 refrigerator cars.

The Lake Erie & Northern will build machine shops and other car repair buildings at Brantford, Ont.

The Illinois Central is reported to be considering the establishment of repair shops at Princeton, Ky.

The Great Northern, it is stated, will build a large roundhouse and machine shop at Leavenworth, Wash.

The Great Northern, it is reported, has ordered 69 passenger cars from the American Car & Foundry Co.

The Michigan Central, it is reported, has ordered 10 switching locomotives from the Baldwin Locomotive Works.

The Chicago & North Western will start work at once on its new shops at Clinton, Ia. The American Bridge Co. will fabricate the steel.

The Atlanta & West Point has ordered 2 Pacific type locomotives and 1 six-wheel switching locomotive from the American Locomotive Co.

The Chicago, St. Paul, Minneapolis & Omaha has begun work on a new 32-stall roundhouse, machine shops and other improvements at Altoona, Wis.

An expenditure of about $250,000 is proposed by the Denver & Rio Grande for the construction of new roundhouse, machine shops and tracks at Grand Junction, Colo.

The Baldwin Locomotive Works is preparing to begin construction on the first unit of its new plant at East Chicago, Ind., for which approximately 370 acres of land was purchased last year.

The Seaboard Air Line has ordered 500 box cars from the Pressed Steel Car Co., 250 flat cars from the American Car & Foundry Co., and 250 hopper cars from the Standard Steel Car Co.

The Seaboard Air Line is reported to have placed orders for 35 Pacific locomotives for freight service, 5 Pacific locomotives for passenger service and 5 switchers with the American Locomotive Co.

The Texas & New Orleans is in the market for 3 combination baggage mail cars, 2 combination baggage and express, 2 second-class coaches, 3 combination smoker second-class cars and 3 first-class coaches.

Work is nearly completed on the improvements of the Chicago, Milwaukee & St. Paul shops at Tacoma, Wash., and delivery of new machinery is being made. The capacity of the shops will be about doubled.

The Baldwin Locomotive Works, it is reported, has received orders for 10 switching locomotives from the Michigan Central, 10 of the same type from the Cleveland, Cincinnati, Chicago & St. Louis, and 5 mikado type from the Southern Pacific.

The Cincinnati, Hamilton & Dayton will, it is said, largely increase the capacity of all departments of the Lima shops, and as soon as the improvements are completed Lima shops will take care of work now done at Dayton and other smaller shops.

Books, Bulletins, Catalogues, Etc.

Steel.

The Norman W. Henley Co., 132 Nassau street, New York, has published a new edition of an excellent work on the subject of steel, its selection, annealing, hardening and tempering, by E. R. Markham. It extends to nearly 400 pages, price $2.50. The work has already passed through several extensive additions, each carefully revised and added to by the accomplished author who has given a lifetime of study to the subject. The book is fully illustrated and shows in a brief but comprehensive way all the details necessary in the selection of steel suited for various purposes, directions for heating and making tools, particularly taps, reamers, drills and milling cutters. Hardening and tempering are also fully described. Springs, saws, chisels and other wood-working tools are described and the best methods of their manufacture are pointed out. Formulas for mixtures and baths are given, in brief, every detail essential to steel selecting and working are given, and all who are interested in these subjects should secure a copy of this work and know all that is to be known in regard to steel and its uses. The book is finely bound and beautifully printed.

Holmes Hinkley.

It is fortunate that nearly all of the pioneers in the development of the locomotive have found biographers who have taken pains to present in book form the interesting details of the struggles of those whose life work did so much to make the locomotives and railroad appliances what they are today. Dr. Angus Sinclair has presented the salient features of their lives and their contributions to railroad engineering in his monumental work, "The Development of the Locomotive," but to those who are interested in fuller details, the separate histories are of real value. The work before us by M. Walter S. Hinchman on the subject of Holmes Hinkley, an industrial pioneer, is the work of a kindly hand, who has spared no pains to present in the fullest light the life of this fine specimen of a New England engineer who contributed much to the development of the locomotive. The book is issued by the Riverside Press, Boston, Mass., and sold at one dollar.

Garlock Packings

The Garlock Packing Company's products are described and illustrated in their new catalogue of 140 pages just issued Their fibrous and metallic packings are so well known that a full description is not necessary, but it is very interesting to note the new uses to which the company's packings are being put and how completely the packing meets every new situation. In this regard the flexible metal packing has proved its superiority over every other kind of packing. All interested in any kind of packing for steam or hydraulic purposes should procure a copy of the new Catalogue O-1913. Copies may be had on application to the company's New York office, 114 Liberty street.

Automatic Ventilators.

The subject of car ventilation is fully treated in the new illustrated catalogue just issued by the Automatic Car Ventilator Company. The public mind has been slow in awakening to the physical evils arising from insufficient ventilation. The special object of the catalogue is to call the attention of those charged with the construction and maintenance of cars for public service to the perfected automatic ventilators supplied by the company. The various types of ventilators are fully described and finely illustrated. Some have been in use for a number of years, and detailed test reports of actual service show the superiority of the company's products. For details of the newer designs, copies of the catalogue may be had on application to the company's New York office, No. 2 Rector street.

Heating and Lighting.

Most railway men are interested in the lighting of offices, stations, waiting rooms, train sheds and railway properties generally. This matter calls for more ingenuity than is usually recognized. An important portion of the work in this great field is ably discussed and illustrated in No. 7, of the present year's issue of the Safety Heating and Lighting News published at No. 2 Rector street, New York. A full display of the company's important devices will be exhibited at the M. M. and M. C. B. convention at Atlantic City, where many new improvements will be demonstrated. Those who are interested in the subject and may not be able to attend the exhibition referred to should secure a copy of the News, which may be had on application.

Graphite in Boilers.

A very interesting booklet has just been issued by the Joseph Dixon Crucible Company on the use of graphite in boilers. Repeated experiments have shown that the application of graphite, while it does not dissolve the scale in boilers, it works its way into the minute cracks existing in the old, hard scale and gradually penetrates between the scale and the metal, and the scale becoming loosened is easily rapped off. Not only so, but

once cleared, the scale will never adhere to the boiler again as long as the graphite is used. It is certain that graphite makes boiler cleaning positive and easy. The methods of feeding the graphite and other particulars are fully described in the booklet, copies of which may be had on application to the company's office, Jersey City, N. J.

Pneumatic Tools.

The Chicago Pneumatic Tool Company's Compressor Department Bulletin No. 34-L, is just received from the press. This bulletin is one of the series covering the complete compressor line, and treats particularly of general engineering information of value to users of compressed air. It contains tables giving efficiencies of air compression at different altitudes, density of gases and vapors, mean effective pressures and horse powers, loss of pressure due to friction in pipes, and many others, some rare and all important. Also information for intending purchasers, showing the data required for intelligent estimates. Views of various types of compressors are shown in miniature, as well as illustrations showing the interior of the Pneumatic Tool Company's compressor plant at Franklin, Pa. This bulletin is sent gratis to those interested, upon application to the Chicago Pneumatic Tool Company, Fisher Building, Chicago, or No. 50 Church street, New York City, or any of its branches in all large cities.

Steam and Water Circulation.

The Gold Car Heating and Lighting Company, 17 Battery Place, New York, have issued a book of instructions relating to the installation and regulation of steam heat and hot water circulating systems for passenger trains, particularly for the use of passenger trainmen, engineers, car inspectors and others. As is well known, these attachments are located in the cab of the locomotive, the train pipes being connected under the locomotive tender by suitable hose and couplings. The details of the equipment are clearly described and illustrated in the instruction book. A careful perusal of the book will well repay all who are interested in the subject, and copies may be had on application.

Hot Water Injector.

No improvement of great importance in injectors has been made since their introduction by M. Giffard in 1859, until recently, when Messrs. E. Davies and J. Metcalfe, after prolonged experiments invented their Flap-nozzle injector, introducing the automatic re-starting feature in injectors. This feature is being rapidly adopted. The latest improvement made by these clever engineers is the Hot Water injectors, a demand for which has arisen especially in hot climates for an injection capable of handling hot feed water. Water at 140 degs. Fahr., with a boiler pressure of 180 pounds, may be readily handled by this injector, and it has also the important feature of perfect automatic and re-starting action. It has been found to be perfectly reliable in the hottest climates. It will also feed with high lifts. A full description with illustrations are furnished in a bulletin of 24 pages published by the company, whose engineering works are located at Romiley, Manchester, England. Manning, Maxwell and Moore, 89 Liberty street, are the American agents of the inventor's devices, from whom full particulars may be obtained.

Headlights on Locomotives.

An important contribution to the railroad literature of our time has been made by the Brotherhood of Locomotive Engineers of the State of Tennessee. It consists of a complete report of the arguments for and against a bill to require good headlights on the engines in Tennessee. While the evidence is somewhat contradictory as to the merits of various headlights there is a mass of information on the subject that cannot fail to be of much interest to all who are interested in the introduction of the best possible method of furnishing good headlights on locomotives. Copies of the report may be had on application to Mr. W. W. Fidler, secretary, Nashville, Tenn.

Safety Valve Rating.

Mr. Alfred B. Carhart, an eminent engineer and member of the American Society of Mechanical Engineers, has just published from the press of the Geo. H. Ellis Company of Boston, Mass., a book on the above subject wherein he discusses very clearly a comparison of safety valves rules and proposed new rules. Mr. Carhart has thoroughly mastered the subject and his deductions cannot fail to have a marked impression on the future regulations in regard to this important subject. The calculations are given in detail. The Crosby Steam Gauge and Valve Company, 95 Oliver street, Boston, will furnish copies of the book to all who are interested in the subject.

Some men control their business; others are controlled by it. Some men are more self-sacrificing than others, some are more industrious, but when all is said and done, the only real way to get a man to work well is to offer him something worth working for.

A good definition of standardization in the engineering sense is to say that it means the elimination of the unnecessary.

Railway Supply Permanent Exhibit

Notes of the Exhibits and Other Items

Flexible Hose.

The Mulconroy Company, 722 Arch street, Philadelphia, have an interesting exhibit at the Karpen Building, Chicago, of a variety of flexible, metallic, boiler-washout hose. This hose has earned the deserved reputation of being the hose that is readily adaptable to any kind of service, and together with Mulconroy couplings are safe, strong, permanent and reliable. Repeated experiments have shown that the couplings will not blow off under the highest pressure. Tests of 2,000 pounds hydraulic pressure have failed to affect the couplings in any way. Every part of these substantial couplings is made of extra heavy malleable iron. The washout hose has two tubes, both of which are seamless, and entirely independent of each other. A fine outside wire braiding takes the place of several plies of duck and a spiral concave wire protects the hose from wear and abuse. The hose is so constructed that it cannot twist or kink, and it cannot be injured by being dragged from place to place. It has also the merit of being about 50 per cent. cheaper than ordinary hose. The fact that over one hundred of the leading railroads in America are using the hose is the best proof of its adaptability to the service requirements.

Railway Men Welcome.

An open letter published by Mr. Allen Sheldon, manager of the Railway Supply Permanent Exhibit, sets forth the fact that the management not only welcomes railway men, but does everything in its power to induce them to frequently visit the exhibit.

The railway man is accorded all the facilities of a club, the privilege of viewing at his leisure and without molestation many new and interesting railway contrivances, or if he chooses he is given writing materials, a lounging chair or whatever else he may suggest, and when he is ensconced in the space set aside for the use of railway men he is protected from intrusion. If he is just in off the train he can drop in there and lose the grime of his trip in a convenient lavatory, breakfast in the club at a very reasonable rate, pick up his mail at the office, dictate a few letters and go about his other business, or if he chooses telephone his friends to meet him at the exhibit or at the club room.

Activity at the Exhibit.

Mr. Allen Sheldon, who for a long time was assistant manager of the Railway Supply Permanent Exhibit, and who was a few months ago promoted to the office of manager, has certainly proved his worth in the latter capacity.

Mr. Sheldon has made each exhibitor his personal friend, and the growing popularity of the Permanent Exhibit is evidenced by the recent acquisitions to its list of exhibitors.

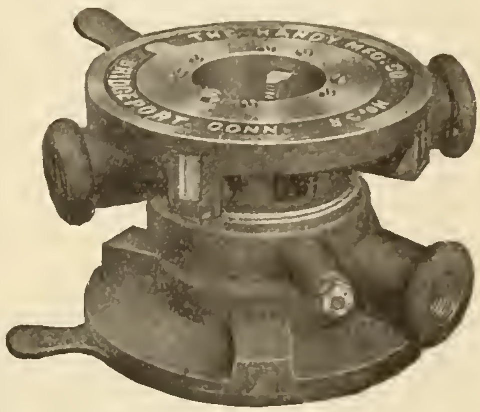
Mr. Sheldon has a friendly way of receiving a stranger, whether he be a railway official, a prospective exhibitor, or a messenger boy looking for some individual in the organization. In a proposition of this nature one would expect a certain amount of discord arising from various causes, but strangely enough, there is no suggestion of any such thing here.

An exhibitor is dissatisfied perhaps with his location which, when he signed his lease, looked to him very suitable, but he finds that he is too remote from a certain line of exhibits which he would wish to be near, he goes to Mr. Sheldon and it has become a by-word that "Sheldon will fix it." Then the next man has a grouch sprouted because he wants to be quiet and secluded and Sheldon just puts him in the quiet corner just vacated, and the grouch is smile-quashed.

A private post office was recently installed and each exhibitor now has his own mail box without extra charge.

Serviceable Threading Tools.

The display of the Handy Manufacturing Company of their handy die stocks. "The Stock That Locks," attracts the attention of all the visitors to the Karpen Building who are interested in pipe threading. The "Handy" line of pipe threading tools is suitable for threading gas, air, steam and water pipe, as well as rigid iron conduit for electricians. Their most recent production, the 3R Handy Ratchet Die Stock, is attracting attention. It is a ratchet threader accommodating pipe from 1 to 2 inches, inclusive, without requiring the assistance of a leader screw. It is designed with a quick release, which the manufacturers claim effects a saving in the time necessary to remove the tool after a thread has been cut. The 3R Handy Ratchet swings in a 10-inch space, permitting it to be used in very close quarters. Considerable care has been taken to design this tool so as to insure perfect threads at all times. Mr. H. S. Ashmun is the Chicago maanger of the company. The factory is at Bridgeport, Conn. Mr. Ashmun's address is 1200 Karpen Building, Chicago, Ill.



THE STOCK THAT LOCKS.

Car Inspection.

At the meeting of the Car Foremen's Association held in the Karpen Building last month, an able paper was presented by Mr. C. J. Wymer on "The Methods of Developing Efficient Car Inspectors." Among other valuable observations, Mr. Wymer said that car inspectors may be classified as terminal and interchange inspectors. Their duties in many respects are the same, and in others so different that an inspector thoroughly capable on terminal work might prove very incapable on interchange work. The most essential duty of a terminal inspector is to discover defects in equipment and be qualified to pass judgment as to whether the defects are of such a nature as would make the movement of the equipment hazardous to life and property. An ideal interchange inspector must possess all the qualifications of a terminal inspector, as well as additional qualifications, and they being the most difficult to obtain, we will confine our discussion to this class, believing that if we find ways and means of supplying the interchange field with efficient men, we will not want for either.

As previously stated, an inspector must be able to discover defective equipment and pass judgment as to whether the defect is of such vital importance as to justify the detention of the car and the attendant expenses. He must therefore be a careful workman and should possess a practical knowledge of car construction.

He must interchange cars and place responsibility according to M. C. B. rules and other regulations. This requires a thorough knowledge of all rules affecting his work.

He must know that cars are equipped with proper safety appliances and due precaution taken with cars containing explosives and inflammable material. To do this he must have definite knowledge of both State and Federal safety appliance laws and their regulations relative to handling explosives and inflammable material.

He must determine if the lading is properly loaded and protected, and in some instances record seal records. This requires a knowledge of the rules for loading materials and sufficient interest in providing protection to lading as will avoid claims for "loss and damage."

He must avoid excessive delays to traffic due to inspection or be a subject of criticism. Accuracy and activity meet this requirement.

He must perform long hours of toil, endure the inclemencies of weather and be regular in service. To do this, he must be of good physique and of exemplary habits.

He must record and transmit intelligently to his superiors his various performance of duties. This requires a good average education.

It needs to be understood that just anything is not good enough for the car department, but that it is an important department, and its efficiency very largely affects the earning capacity of the railroad. When this is understood and the car department has been given a setting in the railroad organization equal to its share of responsibility, there will be no scarcity of suitable material to develop.

Care and Maintenance of Air Brakes.

The report of the previous meeting of the Car Foremen's Association reached us too late for notice in the current issue of RAILWAY AND LOCOMOTIVE ENGINEERING, but the paper presented on the above subject by Mr. Ralph Wolf, who was unavoidably absent, and which was read by the secretary, Mr. Aaron Kline, and which was discussed at considerable length by a large number of the members present, was of such importance to railroad men generally that we take pleasure in reproducing the document.

"On account of the increased efficiency of the locomotives throughout the country which has resulted in the handling of eighty and one hundred and twenty-five car trains, it has brought about a more severe inspection of the air brake apparatus in order that the proper results may be obtained, which is not only the question of stopping the trains, but the results obtained at the time the stop is being made. With the increased efficiency of the locomotive the capacity of the cars have also increased, which has resulted in a larger volume of air to be handled and carried on each car to get the required braking power. This, of course, has resulted in the increasing of the pump capacity on the locomotive from 66 cubic feet of free air to be handled per minute to 131, or in other words, the pump capacity has increased 100 per cent. With the increased pump capacity and the increased volume of air, in order to get the proper operation of the brakes, there are many factors to be taken into consideration.

"First.—The efficiency of the pump and what it costs to pump against leakage on big trains.

"Second.—The brake pipe leakage and if the rate of reduction is sufficient to cause undesired quick action of the triples.

"Third.—The length of piston travel in order to get the proper brake cylinder pressure on a given brake pipe reduction, which will have the proper retarding effects on each car.

"Fourth.—The results obtained due to unequal distribution of braking power thoughout the train. While the question of leakage is the most important factor of all, with an 80-car train of ten-inch equipment we have a volume of 275,200 cubic inches. If the conditions were such that we had a 12-pound brake pipe leakage per minute, we would be losing 130 cubic feet of free air per minute, which would be equivalent to the efficiency of the 8½-inch cross compound pump. If the leakage was 6 pounds per minute, we would be losing 65.5 cubic feet of free air per minute, which would be equivalent to the efficiency of the 11-inch pump. It is estimated that the 11-inch pump consumes 200 pounds of coal per hour; this would require 4,800 pounds of coal to operate the pump for twenty-four hours. Estimating the price of the coal at $2.00 per ton, it would cost $9.60 to pump against a six-pound leakage on an 80-car train for twenty-four hours. If thirty trains were being handled under the same conditions for twenty-four hours, it would cost $288.00 for fuel alone. While working under the same conditions with the 8½-inch cross compound pump, the cost of fuel would be approximately $100.00 pumping against leakage.

"With the cost of pumping against leakage, the question of handling the train without damage to the equipment has got to be considered as well, and what will take place when an automatic brake application is made. If with a 12-pound brake pipe leakage per minute on an 80-car train, we lose 130 cubic feet of free air per minute and when an automatic brake application is made, the rate of reduction is increased 76 cubic feet of free air per minute or a total of 206 cubic feet of free air per minute, which will cause all triples to move to full service position, and if we have a valve in the train that is sticky or has port restriction, we will get undesired quick action, and in many cases the result is, the ends or two or three cars and as many draw bars are pulled out. While it is readily observed that under the above conditions the engineer has no control of the brakes in the way of a given brake pipe reduction. However, there has been a decided improvement in the way of brakes sticking and undesired quick action. This is brought about by the close attention given the triples, as well as the tests they are subject to on the improved test racks. But the conditions relative to leakage remain about the same; this is due to the fact that the test given the cars at the time of cleaning is not severe enough to develop the small leaks that give the trouble, as it is customary when a car is cleaned to attach a hose to the brake pipe and test for piston travel and such leaks as can be observed by hearing. If the cars were tested by coupling a dummy coupling to the opposite end of car from where the test hose is applied and the joints and angle cocks coated with soap suds, it would develop the small leaks, which are the ones that are causing the trouble. This would show about 60 per cent. of the angle cock plugs to be leaking on account of foreign matter being collected on the plug holding it from the seat, and 50 per cent. of the hose couplings to be leaky on account of improper application of the gaskets, which are the principal leaks that cause the trouble. This might require more help and a consumption of more material; but, figuring the cost of pumping against leakage and the cost of maintenance of the equipment, it will develop to a soap-suds test for all cars when on repair tracks, which is the only way to overcome the excessive leakage in the large trains that are being handled."

In the course of the discussion that followed Mr. Weissner, of the Rock Island, said, "that the eleven-inch pump is good for a train of fifty cars and a great many roads are putting on from sixty to seventy cars, and it is almost an impossibility to pump the air up with an eleven-inch pump to seventy pounds on a train of that length. I have found it so in a good many tests, but the New York duplex pump will pump them up to seventy pounds all right. I believe a great deal of trouble is due to the size of the pumps used on the old engines."

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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On the Western Maryland Railway

Starting from the City of Baltimore, and running across the Western Shore of the State of Maryland, the main line of the Western Maryland Railway originally extended just 106 miles to a small point known as Cherry Run, Md. About the year 1902 the Western Maryland, having played the part of a local road for some thirty years, began the great task of entering the western field, and today has succeeded in becoming a link in a great east and west trunk line. It is true that to date the work has only partially been completed; but give this enterprising road a few more years, and we shall have in the Western Maryland one of the leading east and west lines touching the Atlantic seaboard.

In the year 1902 this road, including its branches, consisted of about 250 miles of single track road. Its rolling stock consisted of ancient locomotives and cars, of which there were but few. Today, with its 1,000 miles of road, it is carrying on the work of eliminating curves, reducing grades, increasing its terminal facilities and purchasing of modern rolling stock.

The illustration shows the "West Virginia Limited" as it is leaving Baltimore. It will be noticed that the locomotive is of the Pacific type. The cars are of the steel underframe type and the train is equipped with parlor cars and observation car.

As to the natural resources, an eminent expert has said: "I know of no railway of equal mileage possessing as great natural resources." Besides the surpassing agricultural districts through which its lines pass, mines and quarries of coal, limestone, iron ores, copper, clays and silica sand and vast areas of lumber are found in abundance and of the finest quality.

From the City of Baltimore the road traverses one of the best agricultural districts of the Piedmont plateau, passing through Westminster and other cities until Thurmont is reached. From thence a gradual ascent of the Blue Ridge Mountains is made. As the train ascends the mountain side, it seems that another country is before the traveler, for as he sits in the palatial observation parlor cars or peers from the windows of the new steel framed vestibuled coaches, the broad valleys open into magnificent panoramas. He sees the Horseshoe curve, a point in the road which is of

THE WEST VIRGINIA LIMITED ON THE WESTERN MARYLAND RAILWAY.

much interest to all who travel this line, and as the powerful Baldwins, designed especially for mountain service and which were described in the November number of the RAILWAY AND LOCOMOTIVE ENGINEERING, draw the train over another ridge, the Gettysburg gap is seen in all its beauty. In the distance one can discern the numerous monuments which dot the Battlefield of Gettysburg, 30 miles away. Many of our readers can recall the days of 1861-64. Of course, the terrible struggle at Gettysburg, the world's greatest battlefield, comes vividly before the veteran. Now that the struggle is over and peace has been restored to this mighty land, the battlefield of Gettysburg has been adorned with magnificent monuments, green lawns and substantial avenues. Gettysburg is about three hours' ride from Baltimore and the trip is made through a very interesting country, over what is known as the Baltimore and Harrisburg Division.

TYPE OF BRIDGE ON THE WESTERN MARYLAND RAILWAY.

As the train climbs the mountain side, far beneath can be seen the rippling brooks, and the wooded slopes, at all seasons, making a beautiful aspect. At last Highfield is reached, a junction of the main line and the B. & H. division. In this section of the mountain region we find a vast cottage section. The contrast between the wild and rugged districts through which the road passes in its ascent of the mountains and this cottage section which lies about Highfield and Blue Ridge is so great that one cannot fail to give out some expression of surprise. A large number of the residents of Baltimore, Washington and other cities have their summer homes at this point. Among the distinguished residents is the Japanese ambassador to the United States.

Passing on, we soon reach a point known as Pen Mar. From the train windows can be seen the broad Cumberland and Shenandoah Valleys which spread themselves in full grandeur before the traveler. Our limited space will not permit us to dwell longer on the merits of this scenic and fertile region.

From the Pen Mar region the train rushes into the Cumberland Valley and after a run of about twenty miles, enters the City of Hagerstown, a prosperous city of about 20,000 inhabitants. Passing from Hagerstown, the train whirls out into the Potomac Valley and by the Cumberland Extension passes through Hancock to Cumberland, the second city in size in the State of Maryland. It might be said at this point that the Cumberland Extension between Williamsport and Cumberland was built at a cost of about $130,000 per mile. It crosses the Potomac River nine times in addition to which there are as many tunnels which carry the roadway under the mountains instead of around them or over them.

At Cumberland the Western Maryland is divided, one section extending to the southwest through the Valley of the Blackwater to Elkins, Huttonsville and many other interesting cities of West Virginia. This is known as the West Virginia division. The scenic beauty which meets the traveler's eyes is splendid. To one side can be seen the deep canons and falls of the Blackwater, and Maryland deposits of coal. This division studded with coke ovens, which glow brilliantly in the darkness of the night. This division taps the rich coal and lumber districts of West Virginia. It might be said that about 62 per cent. of the freight hauled over the Western Maryland consists of coal. The division is the outgrowth of the West Virginia Central and Pittsburgh Railway which was purchased by the Western Maryland.

From Cumberland the Erie Extension of the Western Maryland, a line which has just been completed at a cost of nearly $14,000,000, pierces the mountainous districts of Somerset and Fayette counties, Pennsylvania, to Connellsville, where connection is made with the Pittsburgh & Lake Erie Railroad for Pittsburgh, Cleveland, Chicago and the Far West. Some idea of the magnitude of the undertaking can be had, when it is known that the Erie Extension is but 88 miles in length and was built at a cost of $14,000,000. This line boasts of the lowest grades crossing the Allegheny Mountains. Of the many tunnels and bridges, the remarkable cuts and fills, the crowning feature of the work is the tunnel known as the "Big Savage Tunnel." This is the only portion of the Erie Extension which was built to accommodate but one track. The tunnel is lined with concrete and pierces a mountain, the interior of which is a mass of quicksand.

In conclusion, it might be said that since the opening of through traffic between the East and the West, there has been a continuous stream of both freight and passenger traffic over this line. It is particularly noticeable that this prosperous road is still planning extensions into new territory. To the traveler who rides over the well-kept, rock-ballasted road there is no doubt but that the Western Maryland Railway will soon be one of the banner highways of America.

TYPE OF BRIDGE ON THE WESTERN MARYLAND RAILWAY.

Mikado Locomotives for the Grand Trunk Railway

It is interesting to learn that twenty-five locomotives of the 2-8-2 class have recently been delivered to the Grand Trunk Railway by the American Locomotive Company. These engines have proved so satisfactory that an order was placed with the same builders for fifty more of the same design of locomotives.

An interesting feature is the arrangement of the throttle lever support. It combines the lever fulcrum and quadrant support in an integral casting. This means a saving in the number of parts and also a reduction in the number of holes in the back head. It is also universal, as the support fits around the stuffing box as a sleeve, and can be turned to any desired angle to bring the lever in a convenient position. It is also of great advantage as a means of passing obstacles on the back head.

The following comparison of dimensions and ratios with the consolidations replaced might be interesting:

MIKADO, 2-8-2, TYPE LOCOMOTIVE FOR THE GRAND TRUNK RAILWAY.
W. D. Robb, Superintendent of Motive Power. American Locomotive Company, Builders.

The freight traffic on the Grand Trunk Railway has formerly been handled by Richmond compound consolidation type locomotives. The consolidation engines have a total weight, engine and tender, of 349,800 pounds and a tractive power of 34,000 pounds. The Mikados have a total weight, engine and tender, of 455,100 pounds, and a tractive power of 51,700 pounds. With an increase in weight of only 30 per cent., an increase in tractive power of 52 per cent. is obtained. This is another example of where an increase in power far greater than the increase in weight is secured by the application of the latest knowledge and experience in designing. This is very important, as more power per pound of locomotive weight means more revenue from the same motive power investment.

The consolidations are saturated engines, and have a total heating surface of 2,952 square feet. The Mikados have an equivalent heating surface (evaporating heating surface plus 1½ times the superheating surface) of 4,776 square feet, an increase of 62 per cent. over the consolidations, with an increased grate area of only 11½ per cent.

These Mikado locomotives, at present, are doing their best work on the Western division. This division is made up of broken grades which do not exceed 0.6 per cent. except in one case, where a 5-mile 0.95 per cent. grade requires a helper service. These runs are being made over this division with an average speed for the consolidations of 20 miles per hour, and for the Mikados of 22 miles per hour. The consolidations are averaging 38,500 ton miles, and the Mikados are averaging 60,000, an increase of 56 per cent.

Type	2-8-2	2-8-0
Weight on driving wheels, pounds	213,500	183,700
Weight on leading truck, pounds	26,000	25,700
Weight on trailing truck, pounds	43,500	......
Weight, total of engine, pounds	283,000	209,400
Weight of tender, pounds	172,100	140,400
Wheel base, driving, feet and ins	16-6	17-0
Wheel base, total of engine, feet and inches	35-1	25-9
Wheel base, total of engine and tender, ft. and ins.	67-4	57-3
Cylinders, diameter and stroke, inches	27 x 30	22½, 35 x 32
Valves, type	Piston	Piston
Valve gear	Walschaert	Stephenson
Wheels, diameter of driving, inches	63	63
Wheels, diameter of truck, inches	31	31
Wheels, diameter of trailing, inches	43	......
Wheels, diameter of tender, inches	34	34
Journals, driving main, inches	11 x 20	9½ x 12
Journals, driving others, inches	10 x 12	9 x 12
Journals, truck, inches	6½ x 12	6½ x 12
Journals, trailing, inches	8 x 14	......
Journals, tender, inches	6 x 11	5½ x 10
Boiler, type	Ex. wagon top.	Ex. wagon top
Boiler pressure, pounds	175	210
Boiler, outside diameter, front end	74	68⅜
Boiler, outside diameter, back end	83	76
Firebox, length, inches	108⅛	96⅞
Firebox, width, inches	75¼	75¼
Tubes, number and diameter, inches	240-2	353-2
Flues, number and diameter, inches	32-5⅜	......
Tubes, length, feet and inches	20-0	15-0
Heating surface, tubes, square feet	3,398	2,757
Heating surface, firebox, square feet	215	168
Heating surface, arch tubes, square feet	27	27
Heating surface, total square feet	3,640	2,952
Superheating surface, square feet	757	......
Grate area, square feet	56.5	50.6
Water, capacity of tender, gallons	9,000	7,000
Coal, capacity of tender, tons	15	10
Length over all, engine and tender, feet and ins.	78-2⅞	67-4¾
Extreme width, feet and inches	10-4	10-0
Extreme height, feet and inches	15-0½	15-0
Tractive power, maximum, pounds	51,700	63,970

General Correspondence

Jumping the Track.

EDITOR:

I notice an article on page 125 of the April number of your journal where Mr. Nihoff states that he ran a consolidated engine regular, and it is necessary to back his engine over part of the territory he is assigned to, and in backing around curves the rear driver would climb the rail since the engine came out of shop, but took the curves all right prior to going in shop.

He also states that he eliminated the trouble as soon as he located it, and will tell us how it happened if we wish to correspond with him in regard to his findings.

In my opinion, this engine being new out of shop his trouble was due to one of the following defects:

1. There was an obstruction of some kind between the rear pedestal binder and the driving box or cellar—possibly a large nut or a block of wood which would cause the driver flange to be raised over the outside rail on a curve.

2. A main driving box wedge stuck with box low in the jaws, or a back driving box wedge stuck with box high in the jaws.

3. Engine swinging too high behind and too low in front, not allowing enough clearance between binder and the box at the rear.

Very often an engine being jacked up in front last will settle down some after moving across the table, and after releasing the jacks the engine would appear to be perfectly level before moving out of the house. Am I not correct?

F. E. PATTON.

Columbus, Miss.

Quick Job on Wheel Hubs.

EDITOR:

A very quick job was done on an eight wheel (4—4—0) type of locomotive in the roundhouse here. The babbitt collars on both sides of the main driving wheel were so badly worn that a recess in the wheel hubs was about 7/8 in. deep. With an increased amount of traffic and a shortage of engines it was next to impossible to send the engine to the main shop for the purpose of rebabbitting the collars. So a solid cast iron ring was ordered from the main shops a little larger and thicker than would fill the space, so that after machining in the lathe it would properly fit the worn recess.

The machinist started on the job at 7 o'clock in the morning. At 9 o'clock the engine came into the roundhouse, and a gang of men got busy taking the main and side rods down, and lowered the wheel down in the wheel pit. Then one ring was got ready, and the fitters marked the holes for drilling in the ring and also the holes in the wheel, the drilling and tapping being rapidly accomplished, the holes in the metal ring being countersunk to accommodate the heads

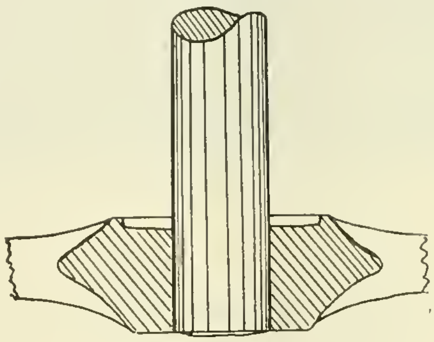


FIG. 1. DRIVING WHEEL HUB.

of the screws or tap bolts. The holes in the driving wheels were drilled with a compressed air drill, and in the back of the ring a groove was cut to facilitate breaking the ring in two pieces. Fig. 1 shows the driving wheel hub, showing recess to receive the new cast iron collar, and Fig. 2 shows the ring divided into two segments so as to be readily slipped into place.

At 7 o'clock in the evening the locomotive left the roundhouse for the purpose of proceeding on its regular trip.

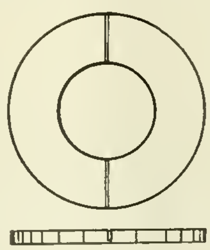


FIG. 2. RING IN SEGMENTS.

Montreal, Canada. J. G. KOPPELL.

Brake Applications.

EDITOR:

Speaking of the disadvantages, as compared with the advantages, encountered, among locomotive engineers, in their every day vocations. Now, if there is a rule in effect that will promote the greatest safety, it is, as a usual thing, the result of careful experiment, and such a rule should have the respect of all whom it governs.

Suppose that there is a rule requiring that in the descent of a 1½ per cent. grade with a train weighing 3,000 tons, at least each brake pipe reduction should not be less than ten pounds, and heavier reductions if necessary, in order to get the best results toward retardation of speed of train and safe control. If the same rule requires that the engineer's brake valve be carried in the full release position, let it be so, there are good and sufficient reasons for it. This full release position of the engineer's brake valve is no respecter of any type of rotary brake valve, not even excepting the famous H-6 brake valve. The S-F-4 governor is not used in connection with the H-6 brake valve here considered, consequently, when the supply valve feed valve handle is adjusted for the purpose of increasing brake pipe and main reservoir pressures, a disappointment is encountered by the engineer. When the adjustment has been made, in the usual way, the brake pipe pressure will build up to about 80 lbs. in brake pipe and auxiliaries, but it will be found that there will be no increase in the main reservoir pressure. This is due to the fact that the high pressure governor head is of the ordinary type, but no matter. In order to comply with the rule involved, the brake valve handle is to be carried in the full release position and a direct communication maintained between the main reservoir and brake pipe. This is done for a valid reason to be now explained. When the brake valve handle is placed in full release, the largest possible opening is established from the main reservoir to the brake pipe, through cavity C in the rotary, port B in the seat, thence through port L into brake pipe. In this way a larger volume of air (compressed) will have access from the main reservoir to the brake pipe and the strong tendency of this is to quickly supply brake pipe reductions, and leakages that are usually present, in all brake pipes. Now then, the real object of the ten pounds reduction in brake pipe pressure is to build up the brake cylinder pressure sufficiently to hold the train under control, in descending this grade. This "Hold" is to be of short duration, then a release of the brakes effected, and with the retainers turned "Up" a slow gradual release of brake cylinder pressure will be the result, and this will practically be due to the cylinder pressure leaking by the retainer valve seat. There are none of these ab-

solutely tight, but the said leakage will be slow enough to retain a certain brake cylinder pressure and thus keep the speed of train from picking up quickly. While this function is being performed, the brake valve handle has been in release position, thereby permitting the free flow of compressed air from the main reservoir to the brake pipe, thus recharging it to maximum pressure, supplying leakages, etc. In the direct communication position of the brake valve, it has been demonstrated that a higher brake pipe and auxiliary pressure can be built up in a shorter period of time than it can be otherwise. Therefore, where the brake "holds" are frequent, the logical thing to do is carry the brake valve handle in the full release position, during the descent of said grade, except, of course, the short period of time required to make the application of the brakes.

At this juncture it is advisable to explain that while controlling a train down this grade, say from 13 to 14 miles per hour, a ten pounds reduction can be made in 10 to 12 seconds, then rotary valve held on lap position for about 15 to 20 seconds, to permit the reduction to take place and steady the speed of train, then the brake valve handle is returned to full release position and the restoration of pressure begins in brake pipe and auxiliaries. At the same time the retainers are holding in check the brake cylinder pressure, thus effecting the greater measure of control. During the period of release, the main reservoir and brake pipe are in communication anywhere from 1 minute and 15 seconds to 2 minutes. This method of brake manipulation assures that brake pipe and auxiliary pressure will be maintained to the highest maximum. If the air compressor can be kept in communication with the brake pipe the greater portion of the time required to make the descent of this grade, with this heavy tonnage train; say for instance, the train consists of from 45 to 55 loaded cars, the work is being performed in the safest way known to modern practices. Anyhow, if there is any better or more satisfactory methods of brake operation for the character of work here under discussion, we have no knowledge of it, then we should adhere to the best and safest way, which, it is assumed, is in accordance with above explanation.

It is a regrettable fact that there are yet a few locomotive engineers who claim that they do not agree with the brake operation here under discussion. They dislike extremely the idea of having to carry the brake valve, especially the H-6, in full release position, as this closes the port leading from the application cylinder to the atmosphere, and if there are any leakages of valve 31, in the distributing valve, or under the rotary valve of the independent valve, pressure is due to these defects and some others not here mentioned built up in the application cylinder, and the engine and tender brakes apply, which is liable to result in over-heated tires, causing them to loosen and move on wheel center, come off, etc. granted. But the driving wheel and tender brakes can be kept released by occasionally moving the independent brake valve to release position, momentarily, and no trouble will be experienced with these brakes. Then there is a way of eliminating the objection and retaining the good points of carrying the brake valve in full release position. Here is another reason why the running position should be avoided in grade braking. With the brake valve handle carried in running position, any air that passes into the brake pipe, must, of necessity, be forced through the feed valve attachment, through ports J in the rotary valve, and F in the seat. This passageway is about the size of an ordinary lead pencil, which offers considerable resistance to the flow of air from the main reservoir. Wire drawing, so to speak, into the brake pipe. Of necessity, this delays the building up of the brake pipe and auxiliary pressure toward the rear of train, and the longer the train, the slower will be the rise of pressure. Now then in the descent of this grade, it has been proven that after 18 or 20 brake applications, to steady the train in the drop, had been made, the pressure at the rear of the train brake pipe had reduced from 90 pounds to 50 pounds. This loss of pressure produced a hazardous condition, and if it were not for the fact that the foot of the grade had been reached, where it was possible to bring the train to a stop with low brake cylinder pressure, a runaway might have been experienced.

Let us allude for a moment to what constitutes the hazardous condition referred to in a preceding paragraph. Suppose that a heavy tonnage train has made the descent of this grade and the brake valve has been carried in the running position. The several brake applications with 6 to 7 pounds brake pipe reductions, which means low brake cylinder pressure, there goes with this method of operation long holds, during these holds, the rotary valve is held on lap, and compressor cut off from supplying pressure to the brake pipe, so when several holds are thus made, while drifting down the grade, and it requires, say, 35 minutes to reach the foot of the hill, and due to the fact that the brakes were held applied for a period of one minute to one minute and thirty seconds, then it will be found, that on nearing the foot of the hill, the brake pipe and auxiliary pressure has been depleted, approximately, 40 pounds. This means that there are but 50 pounds remaining with which it might be necessary to bring the train to a stop, and if this train is to enter a yard limit under these circumstances, which is practically the case, there is possible danger of colliding with a yard engine or the rear of some preceding train. This is a chance that has been taken by some men, and, too, in violation of a specific rule.

On the contrary, it is much better, and positively more in the interest of safety, to bring the train down the grade and maintain the pressure at the maximum, and then if it becomes necessary to stop, to prevent a collision, there is sufficient pressure present in the brake pipe and auxiliaries to do this within shorter limits than it could possibly be done with the depleted, or lower, pressures.

JAS. SPELLEN.
Road Foreman of Engines.
B. R. & P. Ry. DuBois, Pa.

Richard Dudgeon and the Hydraulic Jack.

EDITOR:

In the June issue of RAILWAY AND LOCOMOTIVE ENGINEERING, there is reference to an old acquaintance and friend of mine, Mr. Richard Dudgeon, and his hydraulic jack, of which, beyond question, he was the inventor.

Between 1846 and 1854, I was employed on the Philadelphia & Reading Railway. During a portion of this period Mr. Dudgeon was employed as an engineer on the same road, and ran what was known as the Phoenixville and Pottsville train, as near as I remember, in 1847 and 1848. This train kept him from associating with the other engineers as he laid up over night at Reading. He took his train from Reading about 2 o'clock in the morning on all week days, and ran to Palo Alto, picking up empties on the way, leaving the latter place after the morning passenger train, then ran to Phoenixville and back to Reading, making one and a half day's time in each day. In the afternoon he came into the shop and worked at something that he called a hydraulic jack. There was considerable curiosity in regard to what he expected to accomplish, and when Mr. Dudgeon endeavored to explain his incomplete appliance and the extraordinary weights that he expected to be able to lift with it, he was looked upon as a visionary.

Being anxious to know what a hydraulic jack was, I took pains to make a closer acquaintanceship with Mr. Dudgeon, and we got to be very friendly. Our railroad officials did not think it worth their while to give the jack a trial, and I confess that personally I was somewhat amazed at the success of the invention. Mr. Dudgeon succeeded in finding a party who took an interest in the hydraulic jack and helped him to finance the venture, and so he left the employ of the Philadelphia & Reading, and settled in New York.

E. J. RAUCH.
New York, N. Y.

Annual Convention of the American Railway Master Mechanics' Association

The forty-sixth annual convention of the American Railway Master Mechanics' Association was held at Atlantic City, N. J., beginning June 11th, and continuing during the following two days. The attendance was unusually large and the subjects discussed were greater in number than formerly, and a very keen interest was shown in the proceedings. All of the committees had given considerable time and attention to the preparation of data on the matters referred to them, and the result was that the committees' reports were exceptionally valuable, and furnish an excellent report of the most advanced railroad mechanical practices as well as a clearing of the way for a better solution of the problems that remain unsolved. The number of subjects presented was such that the discussions were in many instances necessarily brief, and the suggestions of the committees in regard to recommended practices as well as other matters were invariably adopted. Considerable time was spent in the reading of the papers which might be utilized in debate, as papers of such importance do not gain in interest by being read, and it is a well known fact that the best mechanics are not always the best readers. Besides if the reports are printed in advance they can be read by the members themselves in advance and an opportunity for preparation for debate is always a decided advantage as the best expression of the best thoughts does not always come spontaneously. The speakers as a rule were clear and decisive, but the penetrating quality of all their voices was not quite equal to the strength of their arguments.

The president, Mr. D. F. Crawford, made a competent presiding officer. His opening address was full of excellent suggestions and showed how earnestly he had the welfare of the association at heart. Mr. J. W. Taylor, the accomplished secretary, presented reports that were models of their kind. His report showed that there were 1074 members in good standing.

The Railway Supply Men's Association had provided as formerly a splendid exhibition of railway appliances which occupied almost the entire space of the great steel pier. The equipment and furnishings and decorations were fine, and as an object lesson in the marked improvement in the multiplex details of railroad mechanism, especially in high speed tools, it was a decided advance over any similar exhibition held under the auspices of the association.

The three sessions of the convention opened at 9:30 a. m., and closed at 1:30 p. m., giving the members and their friends ample time to examine the exhibits, and also to participate in the various entertainments provided by the committees.

Of the subjects presented by papers from special committees, the following are condensed reports:

Mechanical Stokers.

The report of the Committee on Mechanical Stokers, of which Mr. A. Kearney is chairman, presented a lengthy report. This subject has been reported upon at nine successive conventions, and the committee were unanimously of opinion that more progress has been made towards perfecting the mechanical stoker during the last year or little more than during the entire period in which experiments have been made. At the present time the stoker has undoubtedly reached a commercial stage of development.

In all the work and experimentation with the various schemes suggested, two distinct methods or principles for stoking a locomotive still characterize the stage of development. In one the coal is delivered to the fire box over the bed of the fire, not unlike hand-firing, which is generally termed the "scatter" system; while the other delivers the coal up through the bed of the fire from underneath and is designated as the "underfeed" stoker. Both methods have their advocates and strong points of defense. Consequently, having before us the results both types have accomplished, it would be unsafe to conjecture which school will ultimately survive. Probably both will continue to advance, but time only can foretell their fate, and which will in the end prove more economical.

The most prominent designs are the Crawford, typifying the underfeed, and the Street, representing the "scatter" type. The Gee and the Hanna are also of the scatter design. The stokers which are undergoing development are, besides those already named, the Strouse, Barnum, Hayden, Brewster, Harvey, Dickinson, and the Erie. Of these, 76 of the Strouse have been in use on 16 railroads. This design interferes with the operation of the fire door, and the coal must be all shovelled from the tank into a hopper. Of the Barnum type 7 have been in service on the Burlington, and they are still in the experimental stage. The same may be said of the Hayden, Hayden modified, Brewster, Harvey, Dickinson and Erie stokers. Of the 20 Hanna stokers applied on locomotives on the Queen & Crescent railroad, the manufacturers are confident of further improving their device. Only one of the Gee stokers is in service on the Pennsylvania road, and it is giving good results. Of the Crawford stoker, there are 159 in use mostly on the Pennsylvania Lines West, and 140 more are being constructed. The reports are very favorable and it seems likely that the larger locomotives built in future will be equipped with this stoker. There are 189 Street stokers in service on various railroads and 173 are on order. The Crawford and Street designs therefore may be said to stand out from the others in popular favor. The reports are not as complete as would be wished, but the success of these two stokers may be said to be assured. In point of fuel economy the reports are conflicting. In the complete absence of failures there is some economy in the use of the stoker, as the fire door is kept closed and the combustion must necessarily be more complete. Very elaborate tests are under way, but they have not yet progressed sufficiently to justify reliable conclusions.

The committee concluded their report with a list of the following requirements which should, and are being met in the satisfactory stoker:

1. It should convey coal from the tank to the fire box with the minimum of physical work on the part of the fireman.
2. It should maintain a maximum steam pressure on the locomotive, and have a margin for additional feeding capacity.
3. It should leave the fire-box door, and deck as much as practicable, unobstructed.
4. It should maintain an ideal fire for economic fuel consumption.
5. It should distribute fuel in the fire box in such a manner as to reduce to a minimum any necessity for disturbing the fire by means of the hook.

Revision of Standards.

The committee on the revision of standards, of which Mr. W. E. Dunham is chairman, reported at considerable length presenting details in regard to the size of rough and finished bolt heads, castle nuts, cotter pins and the location of cotter pin holes in projecting bolt ends. Gauges for cast-iron wheels were recommended to be made in accordance with the M. C. B. specifications adopted last year. The minimum of cast-iron wheels was also changed to agree with

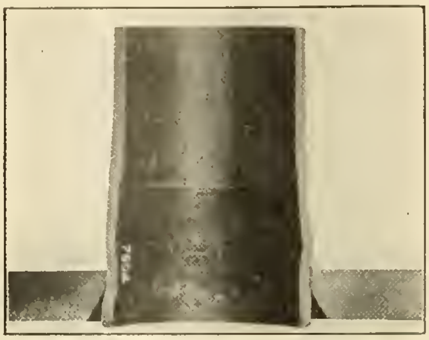
the M. C. B. regulations specifying the weights as 615, 665 and 715 pounds. The same action was taken in regard to conforming with the M. C. B. rules regarding journal box, bearings and wedges, and wheel circumference measure. A recommendation was also made that for engines running local freight trains an allowance of six per cent. to the train mileage be added for switching. In regard to flues on locomotives it was recommended that in practice it is unnecessary to bead all flues in the front end. The adoption as a standard of the Federal regulations for the inspection and testing of boilers and their appurtenances as contained in the order of the Interstate Commerce Commission was recommended. The committee complained that the replies to their circular of inquiries had not brought as many replies as they would have wished.

Design, Construction and Inspection of Locomotive Boilers.

The committee on the above subject, of which Mr. D. R. MacBain was chairman, presented an able report extending to nearly 40 pages of printed matter. The committee reported last year on design and construction, and confined their report this year to the subject of the maintenance of locomotive boilers. The chief difficulties are leaky flues and mud rings, broken stay bolts and cracks in the fire box. Oxy-acetylene or electric welding outfits are rapidly coming into use and meeting the difficulties. The welding of both small and large superheater tubes on the back sheet is being done extensively on some roads. In welding the ends of flues the old flue having been removed, the first operation is to draw the centers of the back and front flue sheets toward each other. The center of the back sheet is drawn forward about 1¾ inches, and the front sheet is drawn backward about 1½ inches. This is accomplished by applying eleven stay rods distributed in a circle about 2½ feet in diameter, one of the rods being located in the center. While these rods are under tension the back flue sheet is annealed around the edges by an oil torch. Rods are then removed and there is a permanent dish in the back sheet of about 1¼ inches, and in the front sheet 1⅛ inches. The holes are then countersunk on the fire side to a depth of ¼-inch with a countersinking tool, the cutting faces of which are at an angle of 90 degrees. Flues are then set in place, projecting ¼-inch beyond the sheet, then rolled and ready to be welded, as shown in the accompanying illustration. When welding on flues the method is to start at the bottom and weld through the center up to the top of the flue sheet, and then from the center out to either side. It should be remembered that the maintenance cost is almost entirely eliminated, also that engine failures are avoided and engines can be kept in service a greater length of time. Present indications are that flues can be run the three-year limit without removal. No roads reported welding tubes on the front tube sheet.

On washout-plug holes patches have been applied 4 or 5 inches in diameter and welded and new holes drilled for the plugs; washout-plug holes have been reinforced around the hole for a distance of ½-inch or more. This work has proved very successful with both types of welders. Boilers should be washed with hot water. It avoids sudden change in temperature by which process the stay bolts and fire box sheets and boiler can be washed clean in a shorter time. Most railroads install hot-water plants when building new roundhouses.

When washing with cold water, care should be taken that the boiler is properly cooled before cold water is turned into same. The general practice is to remove two washout plugs in the backhead above crownsheet, connect the cold-water hose to the feed pipe, which allows the cold water to pass through the injectors and boiler check and mix with the hot water in the boiler, thereby allowing the water to escape through the washout holes. By this method the boilers may be fairly well cooled down and after this has been accomplished all washout plugs are removed, which will allow the boiler to drain itself. With this method it consumes more time than washing out the boilers with hot water. It requires from forty to sixty minutes to cool the boiler down.



FLUE END READY FOR WELDING.

Of the twenty-four roads reporting, flexible stay bolts are used by all except two. Roads not applying full installation, are applying stay bolts in the breakage zone, which consists of 30 to 35 per cent. of the total number of stay bolts. Results obtained from flexible stay bolts have been very satisfactory up to date.

To get the most efficiency out of a brick arch it must be maintained properly and not often disturbed. The general practice seems to be to remove the center row of bricks when it is found necessary to bore or work on flues. Only enough brick should be taken out to enable the operator to get at the tubes. They must be removed as carefully as possible to avoid breakage. Some roads have a special brick-arch man, day and night, at the large terminals to make repairs to arches and to see that they are kept in good condition. Brick arch should be blown off with air by a pipe put in through the fire-box door with a tee on the end which will blow the dirt, or a portion of it, to the corners where there is an opening which allows it to fall out on the grates.

Steel Tires.

The Committee on Steel Tires, of which Mr. Lacey R. Johnson was chairman, reported that the only change in the specification of last year was that the elasticity should be at least 50 per cent. of the tensile strength. The stock for tires should be made by the open-hearth or crucible process. In the chemical composition of the tires the committee recommended that there should be three classes: (1) passenger engines, (2) freight engines, and (3) switching engines, tender truck, trailers and car wheels.

Class 1.—Carbon, not less than 50 per cent. or over 70 per cent.; Phosphorus, not over 05 per cent.; Manganese, between 50 per cent. and 80 per cent.; Sulphur, not over 05 per cent.

Class 2.—Carbon, not less than 60 per cent. or over 80 per cent.; Phosphorus, not over 05 per cent.; Manganese, between 50 per cent. and 80 per cent.; Sulphur, not over 05 per cent.

Class 3.—Carbon, not less than 70 per cent. or over 85 per cent.; Phosphorus, not over 05 per cent.; Manganese, between 50 per cent. and 80 per cent.; Sulphur, not over 05 per cent.

Main and Side Rods.

The members of the committee on the above subject, of which Mr. W. F. Kiesel, Jr., is chairman, reported two years ago, and were continued with a view to bring the matter up for further consideration for possible adoption for standard practice, reported that as it will be but a short time before heat-treated and alloy steels are introduced, maximum allowable stresses for such materials should be recommended; and that allowable pressure per square inch for pin bearings be specified, and a ratio of length to diameter of pins be established, especially for high-speed engines; and further, that offset rods for locomotives with three pairs of drivers sometimes have all of the offset in rod between two drivers, and none between the third and middle driver. It is then not positively necessary that the total offset be taken as leverage for bending. The committee further reported that a general rule for type of offset rods described can not be formulated without danger of having it misapplied. The rule as given may err slightly on the safe side, but can not be misapplied. It is therefore preferable to make no change.

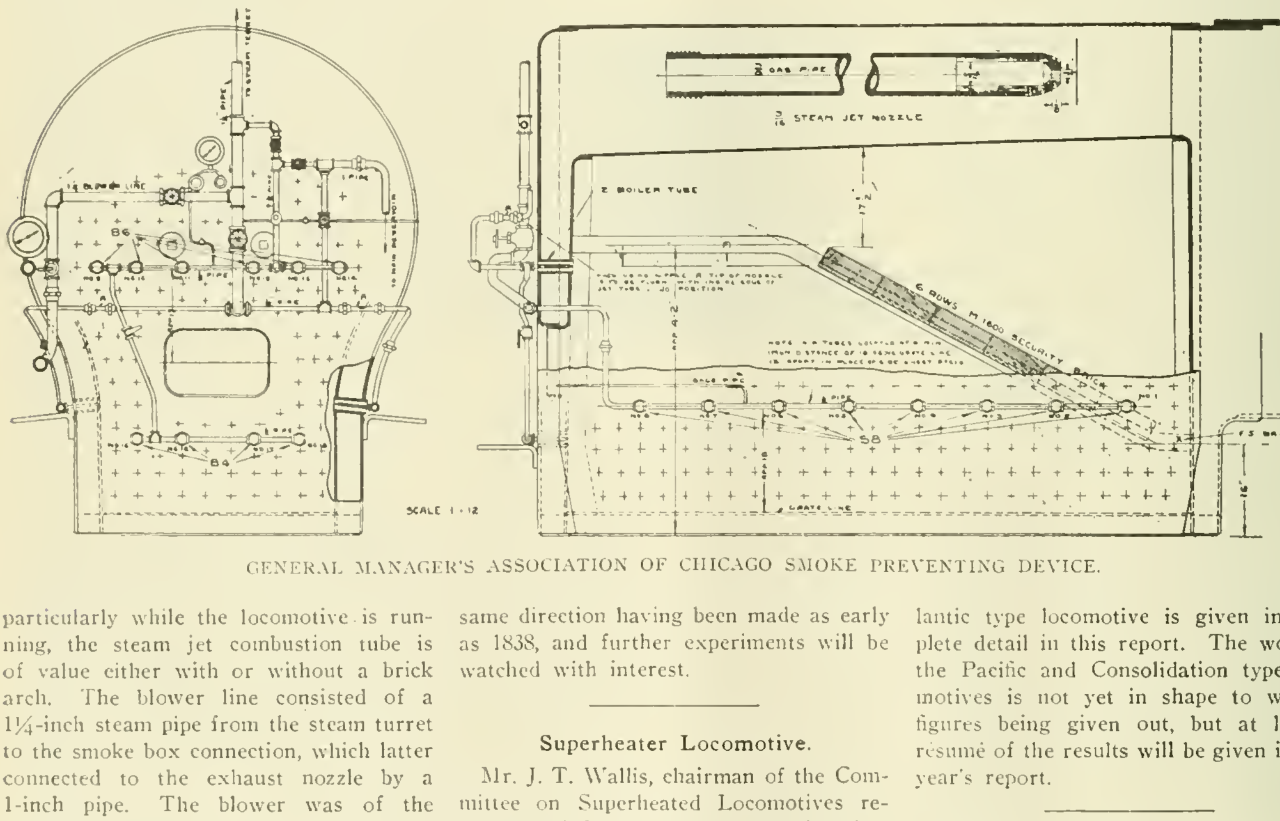
Smoke Prevention.

The Committee on Smoke Prevention, of which Mr. E. W. Pratt is chairman, reported two years ago on an experimental smoke-washing device for roundhouses. Experiments are being continued and an extensive plant is in course of construction, and further information of value may be expected next year. Meanwhile, several of the members were on a special committee appointed by the General Manager's Association of Chicago to determine the advantages of steam jets in locomotive fire boxes as an aid to smoke prevention, and the report of that committee was presented in full to the members of the Master Mechanics' Association.

From this report it appears that of from four to six pounds of air per pound of coal fired is delivered over the fire by steam jet tubes, the emission of smoke will be reduced to a very low amount, and that while the brick arch is a benefit, particularly while the locomotive is running, the steam jet combustion tube is of value either with or without a brick arch. The blower line consisted of a 1¼-inch steam pipe from the steam turret to the smoke box connection, which latter connected to the exhaust nozzle by a 1-inch pipe. The blower was of the double tip nozzle type. The fire door was equipped with an adjustable damper and deflector. Very thorough tests were made. Anemometers were used in computing the amount of air used. The accompanying illustration shows the details of the piping appliance used in injecting the air into the fire box. The minimum smoke with normal brick arch showed a reduction of about 87 per cent. The tests showed conclusively that the air injected over the fire is the greatest factor in smoke reduction. It was also shown that the air should be injected by steam pipes as a small amount of moisture was essential. Steam and air properly combined are superior to air alone in smoke prevention. The brick arch greatly improves the performance of the side jets. The tests also revealed the fact that while running, the brick arch is capable of making a 50 per cent. reduction in smoke, irrespective of the steam jets, while the jet tubes reduce the smoke 60 per cent. without the arch. The steam jet tubes also showed that they had the same effect on the amount of sparks discharged, while the brick arch alone does not reduce the amount of sparks.

It might be thought that the admission of air above the fire would materially reduce the temperature in the fire box. This, however, is not the case. The fire box temperature must be high for the best results, because the injected air could not combine with the combustible gases unless the temperature is sufficiently high.

It may be added that although the results of the tests are generally surprising the idea is not new, experiments in the same direction having been made as early as 1838, and further experiments will be watched with interest.



GENERAL MANAGER'S ASSOCIATION OF CHICAGO SMOKE PREVENTING DEVICE.

Superheater Locomotive.

Mr. J. T. Wallis, chairman of the Committee on Superheated Locomotives reported briefly that since reporting last year there had been an increase in the number of locomotives in the United States and Canada using superheated steam to 8,822, or more than 100 per cent. Reports from the users indicate that they have been uniformly satisfactory. The troubles that were feared with packing and valves, due to the high temperature of superheated steam, have not developed to any great degree, and where there has been any trouble it has been overcome largely, if not entirely, by the use of good material for the parts in question. It is conceded generally that it is necessary to have cylinders, cylinder bushings, valves and valve bushings made of close-grained iron rather harder than is absolutely necessary when using saturated steam, and that iron low in phosphorus and silicon is desirable.

The committee has not been able to determine any definite figure on the comparative cost of maintaining superheated and saturated steam locomotives, but the general consensus of opinion seems to be that the increase, if any, in the cost of maintenance is not going to be of sufficient moment to influence the question one way or the other.

During the year the Pennsylvania Railroad started a series of tests contemplating the comparison of two Atlantic type locomotives, two Pacific and two Consolidation locomotives, of modern size, one of each type equipped with Schmidt superheater, and the other using saturated steam. The tests of the Atlantic and Pacific type locomotives have been completed, and copy of report upon the Atlantic type locomotive is given in complete detail in this report. The work on the Pacific and Consolidation type locomotives is not yet in shape to warrant figures being given out, but at least a resumé of the results will be given in next year's report.

Minimum Requirements for Locomotive Headlights.

The committee on the above subject, of which Mr. D. F. Crawford, the president, is chairman, reported that although they had kept closely in touch with the various tests which have been made on headlights during the past year, they were not in a position to do other than make a report of progress in the matter submitted to them. It was further noted that an analysis of the oil headlight and of various tests run in the past year develops the fact that the distribution of the light with the various detail arrangements vary

to such an extent that it is impossible to make a simple definition of minimum requirements, i. e., it is impossible to designate the minimum size of reflector and candle-power of the source of light without going into the distribution of the light with the headlight as a whole.

As to high powered lights, as for example, the electric headlights: Tests which have been made in the past year confirm the conclusion that they are a decided source of danger when used on roads with multiple track and automatic signals; this confirms the resolution adopted by the association at the 1912 convention.

Specifications for Cast Steel Locomotive Frames.

The committee on the above subject, of which Mr. C. B. Young is chairman, submitted a report briefly stating that there is still considerable difference of opinion among railroad officers, steel manufacturers and locomotive builders in regard to the chemical and physical requirements for cast-steel locomotive frames. The following specification for cast-steel frames was recommended:

Castings must be true to pattern and free from flaws, shrinkage cracks, excessive scale or porosity. When patterns are furnished by a railroad company the manufacturer must make sure that the allowances for shrinkage in the patterns agrees with his own practice, and castings will be rejected, even when made from railroad company's patterns, which do not conform closely to required dimensions. Frames must be made perfectly straight and in true alignment, both vertically and horizontally. Frames will not be accepted which weigh less than 97 per cent. of the weight specified, and material in excess of 6 per cent. above the specified weight will not be paid for. The specified weight must allow a proper amount for finish, as may be agreed on.

The material desired should have a tensile strength of at least 70,000 pounds per square inch; elongation, 20 per cent. in 2 inches, and an elastic limit of 50 per cent. of the tensile strength. Cast-steel frames will be rejected that show a tensile strength of less than 65,000 pounds per square inch, or an elastic limit of less than 30,000 pounds per square inch. With high carbon steel frames, the carbon content must be not less than .37 per cent. and the reduction of area not less than 25 per cent.

Specifications for Materials Used in Locomotive Construction.

Mr. W. C. A. Henry, chairman of the committee on the above subject, reported that the committee had considered the specifications of the American Society for testing materials for lap welded and seamless steel boiler tubes, with a view of harmonizing the specifications, and the committee's recommendations did not differ greatly from those of the American Society. They have, however, been amplified by including arch tubes and the large superheater tubes, instead of being confined to tubes of 2½ inches in diameter and less. The specifications of the American Society for testing materials were given in an appendix.

The standard weights for tubes of various outside diameters and thicknesses are as follows:

Thickness.		Weight, Pounds Per Foot of Length Outside Diameter, Inches.			
Nearest B. w. g.	Inches.	1¾	2	2¼	2½
13	0.095	1.68	1.93	2.19	2.44
12	0.110	1.93	2.22	2.51	2.81
11	0.125	2.17	2.50	2.84	3.17
10	0.135	2.33	2.69	3.05	3.41
9	0.150	2.56	2.96	3.36	3.77

Engine and Tender Wheels.

Mr. W. Garstane, chairman of the above committee, reported that a careful study had been made of the design of solid carbon wheels for engine truck and tender service, and presented a complete specification, with full set of drawings covering designs of the wheels referred to. Various gauges to be used with cast-iron and steel wheels were also shown in the detail recommendations, the specifications and drawings agreeing with revised specifications adopted by the M. C. B. Association in 1912. No action was taken in regard to designs for chilled cast-iron wheels for 140,000-pound capacity tenders, as the question of increased thickness of flange and its relation to frog and guard-rail clearance had not been determined upon. It was recommended that the steel should be made by the open-hearth process, and that a sufficient discard shall be made from the top of each ingot from which the blanks are made to insure freedom from injurious piping and segregation.

The chemical properties of the steel shall be as follows:

	Acid.	Basic.
Carbon	0.60-0.80	0.65-0.85 per cent.
Manganese	0.55-0.80	0.55-0.80 per cent.
Silicon	0.15-0.35	0.10-0.30 per cent.
Phosphorus	Not over 0.05	Not over 0.05 per cent.
Sulphur	Not over 0.05	Not over 0.05 per cent.

Use of Special Alloys and Heat-Treated Steel in Locomotive Construction.

The committee on the above subject, of which Mr. C. D. Young was chairman, reported that they had sent out circulars of inquiry outlining a series of questions, and had received replies from 26 railroads. The replies were so varied as to the use of alloy steel in locomotives that it can only be stated that alloy steels are being used to some extent, the greatest quantity of alloy steels being seemingly confined to locomotive frames, main and parallel rods, piston rods, axles and crank pins, and a few roads are using alloy steels for springs. Vanadium is quite extensively used in frame material. For tires and springs the majority of roads do not require special treatment, and for boiler steel, cast-iron and miscellaneous parts no treatment is required by any of the roads.

In a general way the use of heat-treated carbon and alloy steels has resulted in satisfactory service, increased mileage having been obtained from the materials with apparently fewer failures, although in the majority of the cases the material has not been in service long enough to make a fair reply.

Seven roads replied that they did not require any heat-treated carbon or alloy steel axles and crank pins to be drilled, whereas four roads are at this time requiring drilling for the proper treatment. Present tendency seems to be toward requiring the drilling of shafts of large diameters.

The committee suggested that they be continued with a view of further investigating the subject as more information is developed.

New Locomotive Testing Plant at the University of Illinois.

An excellent individual paper on the above subject was presented by Mr. E. C. Schmidt, Professor of Railway Engineering, University of Illinois, wherein he pointed out the difficulty and expense of maintaining such a plant and the valuable information secured by methods of assured accuracy. All questions, especially those relating to boiler performance can be better and more easily attacked in the testing plant than on the road. Indeed the testing plant makes possible a knowledge of locomotive performance as exact as that which is available concerning the stationary steam engine, the turbine and the gas engine. The details of the laboratory were fully described and illustrated.

In addition to the new equipment discussed, the railway department has for some years owned a dynamometer car fitted for service on steam roads, an electric test car for instruction and research on electric roads, a brake-shoe testing machine and a drop-testing machine. It is believed that this apparatus, the new Transportation Building and Locomotive Laboratory, with the facilities of the other laboratories of the College of Engineering, taken together, provide at the University of Illinois more complete and more adequate facilities for instruction for rail-

way service than are elsewhere available, and that they offer opportunities for research in railway problems which are nowhere excelled. The staff of the railway department appreciates the obligations which these opportunities place upon it and feels confident that it may discharge them with some measure of success, if it continues to receive from railway officers the same interest and coöperation which have been given the department during the six years since it was organized. The action of the university administration in making at this time such an investment for railway engineering instruction is a fitting recognition of the importance of the railway interests and marks a most significant advance in technical education.

Test of Superheater Locomotives.

Prof. C. H. Benjamin, Dean of Purdue University, Ind., presented an individual paper on the above subject. Last year a brief statement of the progress of the work was made, but no definite results were given. Considerable progress had been made during the year. A series of tables were shown representing the results of the tests, and from these it was readily gathered that under nine varying conditions of pressure and cut-off in valve stroke the percentage of increase in favor of the use of superheated steam averaged from 13 to 22.6 per cent., the exact ratio of averages being 16.8 per cent. This average was secured under exact conditions in operating with locomotives of the same size in every detail, but under special conditions the average gain in favor of the superheated engines was much greater, the increase in power of the superheater locomotive over the other for the 160 and 200 pound pressures would be about 25 per cent. if the size of the cylinders were increased. The following table shows the increase of power of the superheater locomotive over the other when using 120 pounds of coal per square foot of grate per hour if the cylinders were increased to 18¾ inches.

Steam Pressure.	I. H. P. Sat.	I. H. P. Sup.	Per Cent Increase in I. H. P.
200	567.8	717.0	26.3
160	553.1	689.0	24.5
120	487.2	636.0	30.0

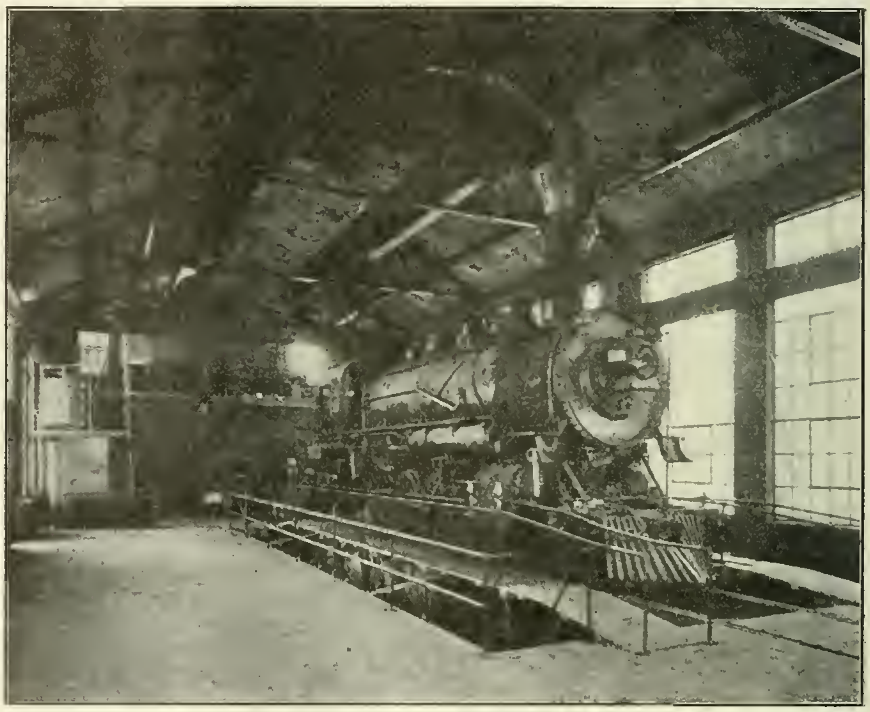
Three-Cylinder Locomotives.

Mr. J. Snowden Bell, the well known engineering writer, presented an individual paper on the above subject, wherein he presented an able review of the development and present status of the three-cylinder design, giving details of various designs from that of Stephenson and Howe in 1846, to the present time. The paper was particularly interesting from a historical point of view and the numerous illustrations accompanying the paper were excellently drawn and showed how carefully Mr. Bell had prepared his subject.

The latest application of the three-cylinder construction within the writer's knowledge, which is one of interest by reason of its continued successful operation in locomotives which are otherwise of approved standard types, was made by the Philadelphia & Reading Ry. Co., who built at their Reading shops three Atlantic type and one 4-6-0 engine, all having three cylinders, from the designs of Mr. Howard D. Taylor, then superintendent of motive power and rolling equipment. The first of these locomotives, No. 303, an Atlantic type, was put in service June 15, 1909; Nos. 300 and 344, of the same type, June 12, 1911 and May 27, 1912, respectively; and No. 675, of the 4-6-0 type, June 12, 1911. They have since been, and now are, in fast passenger service, principally on the New York division of the road, on which they haul trains making the run of 90.2 miles between Jersey City and Philadelphia in 98 minutes, including two stops. They have also been in regular service, during the summer season, between Camden and Atlantic City, on trains making, with punctuality, the run of 55.5 miles in 50 minutes.

So far as relates to the manner of application of three cylinders, the Reading locomotives are similar in construction, the general features of their design being the following: The cylinders are all horizontal and set in line transversely; the piston of the central cylinder is coupled to the pin of a crank on the first driving axle, and those of the outside cylinders to crank pins on the wheels of the second driving axle; the crank pins are set 120 degrees apart. All the cylinders are fitted with piston-distribution valves, that of the central cylinder being operated by a Joy valve gear, and those of the outside cylinders by Walschaert gears.

The most important advantage claimed for the three-cylinder locomotive is the attainment of substantially uniform turning moment, from which there results more rapid acceleration in starting and greatly increased smoothness and steadiness in running; reduced destructive action on rails and bridges; and the exertion of greater tractive power and utilization of a lower factor of adhesion than a two-cylinder engine. The system further affords facilities for providing increased cylinder power, equally divided in a balanced application, at a minimum cost of construction and maintenance, and is adapted for operation upon the simple, compound, or triple-expansion principle.



NEW LOCOMOTIVE TESTING PLANT AT THE UNIVERSITY OF ILLINOIS.

Committee on Subjects.

The Committee on Subjects to be referred to committees to report at the 1914 Convention, and of which Mr. G. W. Wildin was chairman, presented a report enumerating the subjects that had been discussed during the last eleven years, and recommended the following as the programme for 1914:

STANDING COMMITTEES.

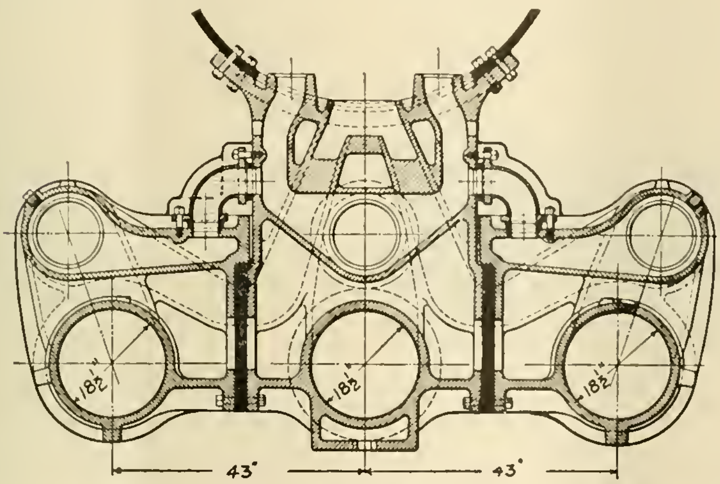
1. Revision of Standards.
2. Mechanical Stokers.

SPECIAL COMMITTEES.

3. Autogenous welding:
   Covering the investigation of electric, gas in its various forms, Thermit, oil and other special methods of welding, with their limitations.
4. Recommended method of calculating stresses in locomotive boilers.
5. Locomotive, counterbalancing of;

does the Rule 1896 meet modern conditions.

6. Maintenance of electric equipment, locomotives and motor cars.
7. Locomotive types:
   Have we reached the limit of Atlantic, ten-wheel and Consolidation types before beginning the development of other and more complicated wheel arrangements.
8. Cylinder lubrication in connection with superheat.
9. Motors for railway shops:
   Various types of both A. C. and D. C., and drives, group or individual—their uses and limitations.
10. Superheater locomotives, with special reference to design of front-end appliances.
11. Proper location and clearances of side bearings on locomotive tender trucks, both forward and rear.
12. Tonnage rating of locomotives—the most practical method.



PROPOSED THREE-CYLINDER TYPE LOCOMOTIVE, AMERICAN LOCOMOTIVE CO.

INDIVIDUAL PAPERS.

13. Has the increased weight of modern locomotives brought a correspondingly increased efficiency.
14. Piston valves, best types and proportions with superheat.
15. The possible reduction of reciprocating parts on a locomotive, with attendant results.

TOPICAL DISCUSSION.

16. Packing rings for pistons and valves in connection with superheat.
17. Locomotive frames, material for.
18. Cylinder lubrication, graphite.
19. Tools and machinery, the safeguarding of.

Officers of the American Railway Master Mechanics' Association.

At the close of the forty-sixth annual convention of the American Railway Master Mechanics' Association the following officers were elected for the current year: President, D. R. McBain, S. M. P., Lake Shore & Michigan Central Railway, Cleveland, O.; first vice-president, F. F. Gaines, S. M. P., Central of Georgia Railway, Savannah, Ga.; second vice-president, E. W. Pratt, ass't. S. M. P., Chicago & North Western Railway, Chicago, Ill.; third vice-president, Wm. Schlafge, G. M. S., Erie Railroad, New York; treasurer, Angus Sinclair, Railway Locomotive Engineering, New York; secretary, Jos. W. Taylor, Old Colony Building, Chicago, Ill.

Executive Committee Members.—G. W. Wildin, M. S., New York, New Haven & Hartford Railroad, New Haven, Conn.; C. F. Giles, S. M., Louisville & Nashville Railroad, Louisville, Ky.; W. J. Jollerton, G. S. M. P., Chicago, Rock Island & Pacific Railway, Chicago, Ill.; J. F. De Voy, Ass't. S. M. P., Chicago, Milwaukee & St. Paul Railway, Milwaukee, Wis.; J. T. Wallis, G. S. M. P., Pennsylvania Railroad, Altoona, Pa.; F. H. Clark, G. S. M. P., Baltimore & Ohio Railroad, Baltimore, Md.

Master Mechanics' Convention Honored the Memory of Henry Schlacks.

When the Master Mechanics' Convention was called to order on June 12, the following incident appears in the minutes of the meeting:

Dr. Angus Sinclair:—

Mr. President and Members of the American Railway Master Mechanics' Association:—It may seem a little invidious of me to select one of those who has passed away for commendation and praise; for I have known all the members who have died, and some of them quite intimately, but a particular friend of mine was Henry Schlacks, whom I knew from the time he was appointed a Master Mechanic until he finished up last month.

I have a telegram from Mr. E. T. Jeffries, one of our honorary members, which reads:—

"I think it would be very appropriate if the Association would adopt suitable memorial resolutions about the death of of our old friend, Henry Schlacks, one of the oldest members of the Association, who died in Chicago on the 16th of last month. I send this telegram knowing that you and he were friends for a great many years."

On account of this and other telegrams I propose a resolution which I hope you will consider favorably in regard to Mr. Schlacks. Those of you who knew him personally will be quite ready to endorse anything that I say. And those of you who have not had the pleasure of knowing that genial, pleasant, splendid mechanic will perhaps be kind enough to take my words for it. I therefore move the following:—

"Resolved, That this Convention expresses warmest sympathy for the widow and family of Henry Schlacks, in the irreparable loss they have sustained in the death of an ideal husband and an affectionate father, which sad event occurred on May 16th last. Also that in the death of Henry Schlacks, this Association has lost a conscientious, hard-working member, who performed valuable services to the railroad world in promoting sound railroad engineering."

Motion seconded by Mr. D. R. MacBain, and unanimously carried and the Resolutions adopted.

Officers of Master Car Builders' Association.

At the forty-seventh annual convention of the Master Car Builders' Association the following officers were elected: For president, Mr. M. K. Barnum. Gen. S. M. P. Illinois Central Railroad. Chicago; first vice-president, Mr. D. F. Crawford, Pennsylvania Lines West; second vice-president, Mr. D. R. McBain, Lake Shore & Michigan Southern Ry.; third vice-president, Mr. R. W. Burnett, Canadian Pacific Ry., and for treasurer, Mr. Jno. S. Lentz, Lehigh Valley R. R. For members of the executive committee Messrs. C. E. Fuller, Union Pacific R. R.; Mr. T. M. Ramsdell, Chicago & Alton R. R., and Mr. C. F. Giles, Louisville & Nashville R. R., were chosen. Mr. M. K. Barnum, the newly elected president, was installed and the past president's badge was presented to Mr. Fuller by Mr. Scott H. Blewett, representing the Supply Manufacturers' Association, after which the convention adjourned.

Railway Statistics.

The annual railway returns for the United Kingdom of Great Britain for 1912 show that the length of line opened for traffic is 23,442 miles; the paid-up capital, £1,334,764,000. Exclusive of season-ticket holders (520,021,000), 1,294,486,000 passengers were carried; while the number of miles covered by all classes of trains was 412,546,000.

Catechism of Railroad Operation

Questions and Answers. Second Series.

(*Continued from page 209.*)

Q. 43. If the valve seat is broken, what can be done?

A. If the valve is provided with false seat as many slide valves are and the ports cannot be covered, would remove the steam chest cover, take up the valve seat, placing the valve down on the old seat, plugging up the hole in the top, disconnect the valve rod, arrange to lubricate cylinder and proceed with engine on one side. Let it be understood, however, that in all cases where there are any broken pieces gone down through the ports that the main rod should be taken down, crosshead blocked securely in order to avoid damage. Where only one bridge is broken the valve can be blocked so as to cover the ports or with one port open to the cylinder. Where the latter method is used the main rod must be taken down and crosshead blocked.

Q. 44. How can you distinguish between a valve, cylinder packing or valve strip blow and locate which side it is on?

A. A valve blow is usually of considerable magnitude and is a steady blow. Cylinder packing usually blows harder on the first part of the stroke, becoming lighter towards the latter and finally ceasing entirely. Valve strip blow is constant but has more of a wheezing sound. To locate while standing, place engine on quarter, cover the ports, block the wheels or set the brakes, open the cylinder cocks and throttle. If steam shows at the cylinder cocks and stack it indicates valve blowing; then move reverse lever forward or back, admitting steam to one end of the cylinder. If steam shows at opposite cylinder cock and stack I would then move the reverse lever in opposite direction, admitting steam to the other end of the cylinder. If steam then shows at opposite end of cylinder from which the steam is in, also at the stack, I would consider cylinder packing leaking. Admitting steam to both ends of cylinder is for the purpose of testing the bridges. The experienced engineer can frequently locate strips blowing by going out and feeling of the valve rod while engine is running. To locate while standing, place engine correctly on the quarter, give the engine steam and move reverse lever back and forth, noting carefully how hard the valve moves; then place engine on quarter on opposite side, repeating the same work over again. Whichever side of the engine is on the quarter when the reverse lever handles the hardest is more than likely the side that the defective strips are on.

Q. 45. Name the different parts of the engine that operate and control the Stephenson valve motion? Walschaert and Young valve motion?

A. The parts that control on the Stephenson are: the reverse lever, reach rod, tumbling shaft arm, tumbling shaft, lifting arms, link lifters and saddle pin. The parts that operate are the eccentrics eccentric straps, eccentric rods, links, link block, link block pins, rocker arms, valve rod, valve stem and valve yoke; also transmission rod on some classes of engine. On the Walschaert valve gear we have the reverse lever, reach rod, tumbling shaft arm and shaft and lifting arms same as for the Stephenson. The operating parts being the eccentrics, eccentric rod, links, link blocks, radius rods, radius rod hangers, combination lever, union link, crosshead arm and valve, in addition to these parts the Young has the combination reach rod transmission bar, rocker arms, wrist plates, valve links, valve cranks and valve rods.

Q. 46. What do you mean by working steam expansively?

A. Permitting steam to flow to the cylinder during a certain part of the piston stroke, then closing the port, allowing the steam to expand until the exhaust is open.

Q. 47. What is meant by outside lap? Why are locomotives given lap, and what is inside lap?

A. Outside lap is the amount that the outside edge of the valve overlaps the steam port when the valve is in mid position; this is sometimes referred to as steam lap. Locomotives are given lap in order that steam may be worked expansively. Inside lap is the amount that the inside edge of the valve or the exhaust edge overlaps the inside edge of the port when the valve is in mid position.

Q. 48. What is meant by the lead of the valve?

A. The lead is the amount that the valve has opened the admission port when the piston is at the end of its stroke.

Q. 49. Why are eccentric blades made adjustable? What effect would be produced on the lap and lead by changing the length of the eccentric blades?

A. Eccentric blades are made adjustable to provide means for squaring the valves or adjusting the travel of the valve over its seat. Changing the length would not effect the lap in any manner, as the lap is a part of the valve and cannot be changed by altering the length of any rods. Changing the length of the blades would only effect the lead inasmuch as what you would take from one end you would give to the other. Lead, however, is given by moving the eccentrics on the journal.

Q. 50. In case you broke down between stations what would you do?

A. First see that the train is properly protected by a flag, then proceed to make the necessary repairs if possible. If repairs could not be made I would endeaver to notify the proper officials and do whatever work I could do to prepare the engine for towing.

Q. 51. If engine goes suddenly lame what might be the cause? How would you be governed?

A. When the engine goes suddenly lame I would endeavor to ascertain the cause before moving the reverse lever, as in case of a hot eccentric or something of that nature moving the reverse lever might cause serious damage. Cracked valve yoke, bent valve rod, bent or loose eccentric rods, loose eccentric strap or loose eccentric on the axle will cause the engine to go lame, sometimes lack of lubrication. I would be governed by the nature of the cause. If it was lack of lubrication I would increase it. If it was anything that was loose I would tighten it. If anything that was bent and I could proceed without delay, even though engine was quite lame, I would endeavor to proceed.

Q. 52. What position on the shaft should the eccentric be relative to the crank pin with a direct motion engine? With indirect engine?

A. With direct inside admission and indirect outside admission the forward motion eccentric should follow the pin a quarter of a turn minus the lap and lead of the valve. The back motion eccentric should lead the pin the same amount while engine is going forward. Indirect inside admission or direct outside admission the forward motion eccentric should lead the pin 90 degrees plus the lap and lead, the back motion following the pin same amount, in case you found eccentric has slipped.

Q. 53. How would you proceed to reset them?

A. In the event of both eccentrics being slipped on one side of an engine would place engine on forward dead center. For direct inside or indirect outside admission engines would place lever in back motion spot, the back motion eccen-

tric with the web pointing toward the ground with cylinder cocks open, crack the throttle slightly, then advance the eccentric toward the main pin until steam shows at front cylinder cock and fasten it there. Then place reverse lever in forward motion spot, forward eccentric above journal a quarter of a turn behind the pin, advance it toward the pin until steam shows at the front cylinder cock and fasten it. In the event of the engine having indirect inside admission or direct outside admission valves would place the forward motion eccentric below the journal and the back motion above the journal, advancing them away from the pin using the cylinder cock and reverse lever the same as described for the first method.

Q. 54. Explain how moving the reverse lever from one end of the quadrant to the other reverses the motion of the engine?

A. Moving the reverse lever from one end of the quadrant to the other places the valve under control of either forward or back motion eccentric thereby changes the port opening, admitting steam either forward or back of the pistons which governs the direction in which the engine will go.

Q. 55. What is the throw of the eccentric?

A. Twice the distance from the center of the eccentric to the center of the axle or it is the large part of the eccentric minus the light part.

Q. 56. What can and should be done in case of a broken eccentric strap or blade?

A. Ordinarily when an eccentric strap or blade breaks the broken parts should be removed, also the good eccentric strap and rod on that side. The valve rod should be disconnected, valve clamped in mid position and link secured so that it will not turn over. In the event, however, of it being necessary to pull the train into a side track or into a terminal for a short distance in order to clear the main line where back motion eccentric strap or blade are broken you can remove the broken parts tie, the end of the link and work the engine in full motion forward. Also in the event of the back strap breaking the back end of back motion blade can be bolted to the back end of forward motion blade and the engine worked in full gear forward.

Q. 57. (a) What can be done in case of link saddle pin, link hanger, or lifting arm being broken?

(b) If lifting shaft, reverse lever or reach rod should break what can be done?

A. (a) Remove the broken parts, if necessary place short block in top of link and long block in the bottom, blocking at such cut-off as will enable the engine to handle the train over any grades in advance. If necessary to reverse the motion of the engine, change the blocks in the link.

(b) If reverse lever, reach rod or reversing arm should break block the links by placing short blocks in the top and long blocks in the bottom, allowing for the slot. It is the opinion, however, on some roads that it is only necessary to block in one link. Still another method that can be used on some classes of engine is to place a bar across above the engine frame under the lifting arms and securing it there.

Road Rival of the Locomotive.

When locomotives were first put into service five to six horsepower was the most common capacity, and it took twenty years of development before 100 horsepower capacity was achieved. Road engines appear to be developing much more rapidly. Our Glasgow agent, Mr. A. F. Sinclair, in a recent contribution to the Glasgow *Herald,* describes a new tractor which displays extraordinary progress in the line of highway transportation. To quote:

"Halley's Industrial Motors having been requested by certain Colonial friends to design and build a heavy motor vehicle for use in carrying a load and hauling a trailer in rough country, where

ELECTRIC MOTOR IN SOUTH AFRICA.

roads are most conspicuous by their scarcity, have turned out a substantial and powerful wagon tractor. As the vehicle is the first of the kind constructed in Scotland, a few details will be found of interest.

"The frame is a strong girder type structure of heavy section, and is carried on a specially designed pivoted nickel steel front axle, providing for the wheels rising and falling with the inequalities of the ground, while the body continues to run on an even keel, as one may put it. The back axle, also of nickel steel, is of the fixed type, while the large rear wheels are driven by chains and gearing. In consequence of the rough travel in which the vehicle is to be engaged exceptionally large driving wheels are provided, the diameter being 5 feet, with a one-foot wide tread. Those large wheels necessitated provision of an unusual kind in the way of gear reduction, and this has been attained by a combination of ordinary spur gearing and differential behind the clutch, with chains from a countershaft to sun and planet gearing driving the rear wheels. All the parts of this transmission are enclosed in oil-tight casings of a very robust kind, which at once exclude dust and mud, while forming an oil bath which lubricates the whole mechanism. The driving wheel treads are slotted diagonally to give adhesion on a soft surface, and to give a better application of power there is an arrangement for cutting out the differential. The last feature will be appreciated by such as have found themselves stuck on soft, marshy ground through one wheel slipping.

The engine is a standard six-cylinder Halley, the dimensions being 5 in. bore and 5.25-in. stroke, while the power capable of being produced is 75 h. p. continuously. An extra large radiator is employed, and as a standby there is fitted at the rear a water tank of 50 gallons' capacity. This tank may be filled with water capable of being used for drinking and cooking, should occasion arise. Two ignitions, a Bosch magneto, and separate accumulators are fitted, a wise precaution when one considers the vehicle's future field of employment. The oil is forced to all engine bearings through drilled ducts. The clutch is of the cone type, but a special material instead of leather is used to take the drive to the gearing. The four-speeds and reverse gears are of fool-proof design, the spur-wheels being always in mesh, any particular speed required being brought into operation by means of a dog-clutch. Some of the unusual features of the vehicle are the long spring in front set transversely, radius rods connected by means of bevel gearing to give easy and correct adjustment, and exceptionally powerful winding drums attached to the rear axle. Those drums are for loading and unloading if needed, but their primary purpose is to haul the tractor out of the mire should occasion arise, all four forward speeds being available for the work.

Energy of Grain.

The energy which may be derived from the oxidation of grain has as yet only been artificially developed in the form of heat, and this may be the only way; but physiology has not yet advanced to the point of explaining the physical process of the development of energy consequent on the oxidation of the blood, and it is at all events an open question whether the energy of grain may not be a form of directed energy, in which case grain would yield six or eight times as much energy as coal does at present in making steam for our engines. As consumed in animals, it yields a larger proportion of energy—two or three times as much, and perhaps more—whereas by burning it in boilers we cannot get half as much. Should we find our artificial means of developing anything like the full directable power of grain—a problem which has not yet been attempted—coal would no longer be necessary for power.

General Foremen's Department

Annual Convention of the International General Foremen's Association.

We took occasion last month to call attention to the forthcoming convention of the International General Foremen's Association which will be held in the Hotel Sherman, Chicago, July 15 to 18 inclusive, and also to the important subjects which will be discussed, and we are pleased to be able to state at the present time that Mr. Wm. Hall, the secretary-treasurer, has sent advance copies of the five topics for discussion at the General Foremen's Convention to the members, so that they may fortify themselves and come to the convention fully prepared to criticise and suggest such changes as their opinion should dictate. There is no question but that each topic will be looked at from numerous view points, and the members will come prepared to get all the good they can from the reading and discussion of the several topics, and return home feeling satisfied that their time was well spent.

From present indications the ninth annual convention will be the most successful in the history of the organization.

The papers have been prepared in a painstaking and thoughtful manner and will reflect great credit on the several committees having them in charge. Greater interest is being manifested this year than at any previous time. Applications are coming in in a very gratifying manner, and from roads not heretofore represented. This is due largely to the hearty co-operation and assistance on the part of the superintendents of motive power, who are encouraging their general foremen to become members of the association. A number of application blanks were sent to the superintendents of motive power of every important road in the United States and Canada, and we have been assured by these gentlemen that they will reach the hands of those for whom they were intended, and in several cases have received repeat orders for from ten to twenty more blanks, stating that they recognized the good work that was being accomplished by the General Foremen's Association, and would be pleased to have their foremen become members. This is very encouraging and indicative of the prevailing harmony between the general foremen and the men higher up.

Co-operation, that is the key note of the whole situation, and now that it has ben brought about, much more good can be accomplished than heretofore, and now it is for the general foremen to show their appreciation of recognition by the men higher up by attending the sessions of the convention, and take part in the discussions, and upon their return to their respective shops, carry out some of the ideas gleaned.

It is not altogether what is learned in the convention hall, but in making different acquaintances much can be learned, for an exchange of ideas is the most natural trend of thought, so that the meeting of this or that member is not only pleasant but profitable.

Advance copies have not been sent to just a few of the members, and they alone expected to take part in the proceedings, but a copy has been sent each and every member, and all are given an equal opportunity to express their opinions, which should be done in as brief and concise a manner as possible, so as not to consume too much time. The chief reason for sending out these copies at least thirty days prior to the convention, is to give each one a chance to read and carefully study them, and then come to the session fully prepared and knowing full well what you want to say; let every man take his share in the work of the convention, thereby getting the greatest results.

We need hardly add that it will be a pleasure to us to report as fully as possible an account of the proceedings. We are well aware that the association is doing an important work, and are meeting with a degree of encouragement that is commendable in many ways, and the successful future of the association is assured.

Modern Railroad Methods.

A high official of the Pennsylvania Railroad, speaking about railroading, past and present, said that recruiting men for railway service had been reduced to an exact science. Corporations take unskilled workmen and train them. However good an engineer may be theoretically, he may have to start from the bottom as a fireman—perhaps on a freight train. A physical examination and a test of knowledge of the company's rules were required. Many a college graduate had to begin as a stoker.

Companies, he said, prefer to have their men join a relief department, or schemes of insurance against injury or sickness. It was now illegal to compel them to do so, but a man who refused had little chance of getting the work he was applying for. The average age of men on the Pennsylvania Railway system's relief department books is twenty-seven years, but employers constantly tried to reduce this, and a man over thirty-five years old had very little chance as a rule.

In regard to discipline, he said that foremen had formerly almost unlimited powers of discharge or of suspension for a period of from ten to sixty days, but that a system of records had been now adopted on fifty-seven railroads. Blacklisting was apparently legal, though some western states forbade it, but since it was a confidential system of reports it was difficult to prove. As to pensions on the Pennsylvania system, retirement took place at seventy years, with 1 per cent. of the former salary for each year of service.

"Railroad corporations," he concluded, "are stimulating their employees to save money and to invest it in railroad securities. They have, by reason of the peculiar character of their business, every economic inducement to deal fairly with their men, to promote their welfare in order to secure greater efficiency, and the larger and wiser corporations are doing this as a necessary element in the severe competition for business, and not from the motive of making their labor force dependent and servile, nor the objects of benevolence."

Hardening Soft Iron.

To harden soft iron wet it with water and scatter over its surface powdered yellow prussiate of potash. Then heat to a cherry red heat, which causes the potash to melt and coat the surface of the soft iron. Then immerse quickly in cold water and repeat the operation. A white heat must not be used, as this would not harden but oxidize the iron. Care must be used not to use red prussiate of potash instead of the yellow. It will not answer.

Removing Grease from Paint.

When removing grease from paint by using ordinary cleaners, the paint is liable to come off in the washing. A good and cheaply applied method is to rub the painted surface with a paste of ordinary whiting. This is allowed to dry and when it is rubbed off with a cloth the dirt and grease is taken away with it. The whiting is cheap and can be purchased at any drug store.

The De Voy Engine Trailing Truck.

The favorable reports which are being made in regard to the adoption of the De Voy trailing truck on a large number of Mikado locomotives recently placed in service on the Chicago, Milwaukee & St. Paul Railway, as well as on other roads, renders a brief description of the device of interest to railroad men. It may be stated that the chief aim of the inventor has been to provide improved means for mounting the trailing truck with freedom for lateral movements transversely of the locomotive framework. As is well known hitherto in radial trucks for locomotives the trailing truck has been mounted to move laterally on the arc of a circle, and the movement has been permitted only by overcoming a sliding frictional resistance between parts which carry the load on to the trailing truck. The springs also in the ordinary trailing truck exert a strain tending to maintain the trailing truck in an intermediary position, which position it properly occupies when running on a straight track. The weight, however, is so great that the friction between the parts, which must slip over each other, that the spring device is inefficient to overcome the same, so that the flanges of the wheel are pressed with much force against the rails, especially after having passed from a curve to a straight track.

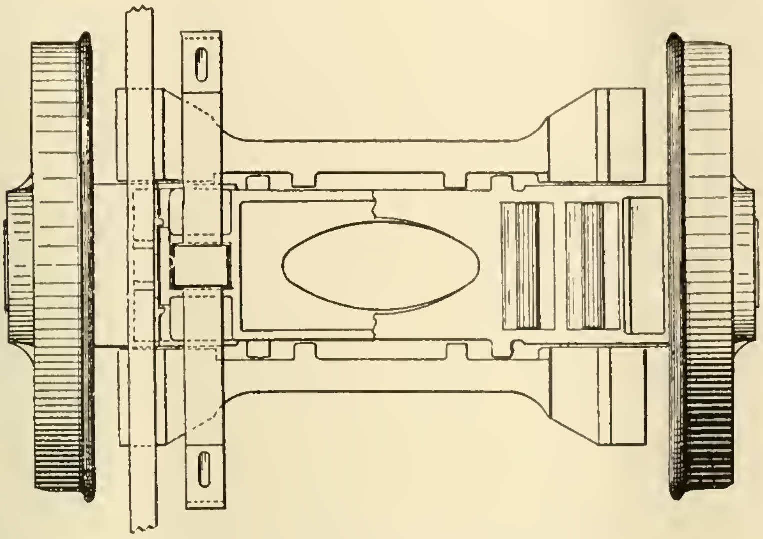


FIG. 1. PLAN VIEW OF DE VOY TRUCK.

As is shown in the accompanying illustrations the De Voy truck is mounted for free lateral movements to adapt itself to a curved track and to a straight track, and the weight of the load exerts force tending to maintain the trailing truck in its intermediary position when on a straight track, and will offer very little friction or resistance to a lateral movement when running on a curved track.

Fig. 1 is a plan view of the De Voy truck, some parts being broken away to show the details of construction, and Fig. 2 is a transverse vertical section of an engine truck equipped with the De Voy device. It will be noted that the locomotive frames are shown in section, to which depending guide pedestals are rigidly secured, the pedestals, which are in line with each other transversely of the truck, being separately formed but securely attached to tie-plates. The lower ends of the pedestals which are on the same side as the truck are held together by bolts, and are spaced apart by spacing sleeves, through which the bolts are passed. The journal boxes are rigidly united, being cast integrally, with a channel-like frame that is open at its bottom. In the top plates of the journal boxes are concave roller-seats, formed directly in the journal boxes. Bearing rollers rest loosely in these roller-seats. Upper roller-bearings or roller-bearing caps are formed integrally with a transverse horizontally-extended tie-plate. The seats as shown are cylindrical, but they may be formed on various lines which will adapt them to co-operate with the bearing rollers to yieldingly maintain the trailing truck in the central position under the weight of the load on the truck.

It will be observed that the roller-bearing caps have upwardly-projecting guide-legs, near their ends, which work against channel-shaped chafing-plates that are rigidly secured to the inner surfaces of the frame members. In this way the roller-caps are held against movements transversely of the main frame of the engine, and are also held against endwise movements with the journal boxes, but are permitted to raise and lower, as may be necessary, under a lateral movement of the wheels.

The main frame or body of the engine is, of course, yieldingly supported by a suitable spring-rigging. Certain members of this spring-rigging rest directly upon the roller bearing caps, elliptical springs being seated upon the caps. The springs are pivoted in the usual way to equalizer beams.

It will thus be seen that a trailing truck mounted in this way is free for lateral movements; that is, movements transversely of the body of the locomotive, and that this movement is resisted by very slight friction, and that the weight of the load has a tendency at all times to maintain the laterally-movable parts of the trailing truck in the intermediary or central position when the locomotive runs from a curved track to a straight track.

The construction is simple and may be applied to any locomotive at a comparatively small cost, while the saving in wear is very great as compared with the ordinary radial truck. It is also readily capable of modification to suit particular classes of locomotives, and there is every indication of the truck coming rapidly into popular use now that it is getting a fair trial on some of the leading railroads in America.

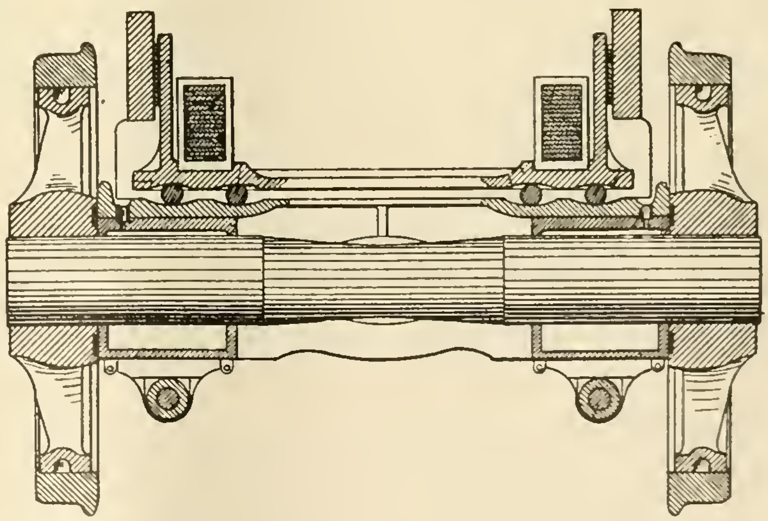


FIG. 2. TRANSVERSE SECTIONAL VIEW OF DE VOY TRUCK.

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Master Mechanics' Convention.

The Forty-sixth Annual Convention of the American Railway Master Mechanics' Association, held at Atlantic City, June 11, 12 and 13 last, was the most valuable meeting, viewed from the standpoint of railway and engineering interests, that has ever been held. The volume of business done was unprecedented and all of it was valuable in character and unusually interesting. When reviewing the description of subjects we could not see how the business could be finished in three days; but President Crawford adopted a novel method of showing how the work was proceeding which enabled him to push the business as it never was pushed before. He kept a graphic chart which indicated the progress of the work and a glance told when it was lagging or accelerating. When necessary Mr. Crawford applied more steam or touched the brakes, all done so skillfully that the convention finished three minutes ahead of time. We heartily commend Crawford's method to other presiding officers.

The subject which occupied the lion's share of attention was Superheaters and Superheated Steam, originated by an admirable and most exhaustive paper describing Tests on the Locomotive Testing Plant of the Pennsylvania Railroad at Altoona, and a paper on Tests of Superheater Locomotives by Dean C. H. Benjamin of the Perdue testing plant. The subject was thoroughly discussed and it is safe to say that every person in the large audience learned important facts about superheaters that they had no conception of before. The paper describing the work on the Altoona Testing Plant, which was read in abstract by Mr. C. B. Young, engineer of tests, is one of the most valuable contributions to locomotive engineering that we have ever read and ought to be carefully studied by every person interested in locomotive construction and operation. The section devoted to combustion in itself would have made a splendid treatise and it reveals information concerning combustion and draft action which strikes us as being entirely new. Former reports presented to the Railway Master Mechanics' Conventions have given to the railroad world certain stereotyped impressions covering the action of fuel gases which have been accepted as correct and by the paper have been proved to be erroneous.

There has been of late a tendency among locomotive officials to keep increasing the length of flues, and we have heard it claimed that a gain in heat conservation resulted from every inch of increase of length. Those holding such views ought to ponder over paragraph 81 of Mr. Young's paper, which reads:

"Those temperature observations indicate that the gases entering the tubes are of a lower temperature than is shown by a separate pyrometer located in the middle of the firebox. The firebox temperature ranges from 2,000 to 2,400 degrees, while the temperature at the tube ends is from 1,370 to 1,620 degrees. They also show that there is a rapid decrease in temperature for a distance of three or four feet in the tube, after which the temperature drop is much more gradual until even with this short tube (13 ft. 8⅝ in.) the curve becomes flat towards the end of the tube, indicating that a large part of the heat is absorbed before half of the length of the tube is reached."

The paper on Tests of Superheater Locomotives by Dean C. H. Benjamin showed comparison of locomotive performance under different degrees of superheated steam. It also gave particulars of the increased power developed by locomotives using superheated steam as compared with engines using saturated steam, the same weight of coal being consumed in both cases. This paper will prove an interesting reference for people wishing to understand the economical value of locomotive superheaters.

The uncertainty that has prevailed concerning the success or failure of mechanical stokers, which has prevailed for several years, was dissipated by the report of the Standing Committee on Mechanical Stokers. The report opened with the encouraging words:

"The development of the locomotive stoker has been watched by many of us with more than ordinary interest and patience, it being another instance where skill and genius, by the application of mechanics, bids fair to materially reduce physical labor. The utilization of machinery to perform what hitherto was accomplished by manual labor has been achieved in much larger as well as smaller problems, but few have been more welcomed than the automatic or semi-automatic apparatus by which the larger locomotive is successfully supplied with fuel at a rate and in such a manner as to produce efficiency in the operation of the locomotive, with a reduction in physical work on the part of the fireman."

The committee then proceeded to report the progress of the year, which has been very striking, for there are now between six hundred and seven hundred mechanical stokers in successful operation. The successful stokers are confined almost entirely to two forms, the Crawford and the Street, but other inventors are still at work and it is probable that other forms may be introduced that will be even more successful than those in use. So far as we have learned from observation and report the stokers in service are still susceptible to improvement, but they are as efficient as many appliances now standard on the locomotive were for the first five years after their introduction.

The mechanical stoker is not only fairly successful in its operation, but it is said to be teaching firemen improved methods. The report says that it is admitted by even expert firemen, who have had some years' experience with hand-firing, that they have derived valuable information by handling the stoker and watching its operation. Firemen were said to be opposed to the stoker at first, but most of them have become favorable to its use and give valuable suggestions to the inventors. The report was exhaustively discussed by the convention.

An excellent paper on Three-Cylinder Locomotives was read by Mr. J. Snowden Bell which surprised most of

the members, who had no idea that three-cylinder locomotives had been used so much.

When a man accustomed to locomotive work is informed that it will be necessary for him to handle or repair electrical apparatus, he generally thinks that he is required to enter a field that calls for a technical school training to pave the way to success. This mistaken idea was thoroughly dissipated by Mr. C. H. Quereau in an admirable individual paper on Maintenance of Electric Equipment. Elsewhere we publish this valuable paper in full and feel assured that its contents will prove highly edifying to our numerous readers who are interested in electrical matters without having given the subject serious attention.

This Forty-Sixth Annual Convention of the American Railway Master Mechanics' Association deserves special praise for the large attendance of members and for the exhaustive manner in which they discussed the numerous subjects brought before them. It is not very long ago that much time was wasted at those conventions through difficulty in prevailing on members to discuss the reports, even when they were particularly familiar with the subjects. That condition has passed away and we attribute the change in some measure to the training in public speaking they receive at railway clubs and similar institutions. The members, however, possess a much higher grade of mental training than that found among the old-time master mechanics.

Punishment for Overworking Railroad Employees.

Where laws were enacted in various states restricting the hours of labor of trainmen, it was generally understood that enforcement would be lax, but events indicate that the minions of the law are determined that these laws would be strictly obeyed.

One day last month Judge Morton, of the United States district court, received the verdict of the jury in the case of the United States government against the New York Central & Hudson River Railroad, charged with violation of the law restricting the hours of labor of railroad employees. There were 28 counts in all, each carrying a maximum penalty of $500. The jury returned verdicts for the railroad on 20 counts and for the government on 8 counts, so that the defendant company's fines may amount to a total of $4,000.

The government charged that the railroad worked its trainmen more than 16 hours consecutively on 18 occasions, which is against the law except in cases of unforeseen delay or accident. On the first 10 counts the jury returned in favor of the railroad, and on the other eight for the government.

It was also charged that the defendant company worked its telegraph operators at the Springfield office more than nine hours consecutively on 10 occasions. The jury reported a verdict for the defendant on all 10 counts.

Railroad Rates.

Representatives of the Baltimore & Ohio Railroad Company, the Erie Railroad Company, the New York Central Lines and the Pennsylvania Railroad System held a conference with the Interstate Commerce Commission last month, at which the commission was petitioned to re-open Docket No. 3400—the advance rate case decided in February, 1911.

The commission at that time stated that if conditions changed "there might be ground for asking a further consideration of this subject." The carriers in their petition now say they "believe that the time has now arrived when the results of the operations of the carriers, subsequent to the former consideration of this case, should be laid before the commission."

The carriers propose to make a five per cent. increase in all class and commodity freight rates, submitting that "if an increase in freight rates is permitted, the method of making it which would work the least disturbance of existing relations between classes of traffic and between communities would be that of the same percentage increase in all freight rates, subject to such modifications as may be required to preserve necessary differential relations."

The commission is asked to hear the case and to render its decision without subjecting the railroads to the large expense and delay involved in the preparation of new tariffs.

Increases in wages, taxes, capital charges, and additional legislative burdens, such as extra crew laws, grade crossing bills, employers' liability and compensation acts, and other new expenses, are given as some of the items that have steadily increased the cost of running a railroad, and make higher rates necessary.

The roads contend that many millions of dollars should be spent for improved and additional facilities, such as enlarged yards and terminals, additional tracks, block signals, new shops, stations and new equipment, which "are demanded by existing and future transportation conditions" and must be provided if the needs of the public are to be satisfied.

The roads state that many of these improvements must be paid for out of new capital, which at this time can only be obtained on prohibitive terms, and that it is only through an increase in freight rates that they can provide that margin of surplus which will afford them the credit necessary to procure at reasonable interest charges the additional capital required.

The Stamford Collision.

On June 12 a rear-end collision happened on the New York, New Haven & Hartford Railroad at Stamford, Conn., by which six persons were killed. The trains in collision were the first and second sections of a westbound express. The first section had stopped to change engines and while standing was run into by the second section at a speed of about twenty miles an hour.

The collision was due to the failure of the engineer of the second section, Charles J. Doherty, to stop his train in time. He had only a few days' experience running passenger trains and there is reason to believe that he handled the brakes very unskilfully. His case would indicate that the training of engineers on the New Haven road is defective, for he claimed that the accident was partly due to his inability to reverse the engine, a practice which is strictly forbidden on all well managed railroads.

Wonders of Intense Heat.

It is not long ago since the most intense heat within the range of service was produced by the combustion of carbon and hydrogen, but the vast water power of Niagara Falls was utilized a few years ago to produce intense heat by mechanical means, a method which has been carried to wonderful performances of late years. The manufacture of carbide of calcium for acetylene gas, of the grinding material known as carborundum from ordinary carbonaceous material, of graphite which is reputed to be better than the natural product of the mines, the extraction of refractory metals from their ores and the elimination of phosphorus from metals and its conversion into an article of commerce are examples of the new enterprise made possible by the harnessing of Niagara. The pioneers in this region have also made many metallic alloys which were unknown to industry some years ago. A few years back sodium was a curiosity and cost fifty cents an ounce: produced by intense electrical heat it can now be sold for twenty-five cents a pound, while in the same way manurial nitrates may be produced in bulk.

We copy some interesting facts concerning the invention of carborundum from an article that appeared in *Harper's Weekly*, which says:

"Carborundum could never have been invented in a garret. One man hovered on the borderland of discovery for years.

Clay, coke and sawdust subjected to great heat produced an indefinable something that showed him he was on the right track. He sought more intense heat in an effort to magnify that something which he did not as yet understand. He believed he was on the verge of grasping in unlimited quantity an abrasive purer than any yet known. Emery comes from an impure substance in nature known as corundum. The man in question was trying to combine the silica in the sand and the carbon in the coal in an effort to produce a pure abrasive. So he went to Niagara Falls. With the aid of water churning great electric units he produced the most intense heat known to man. These substances he now placed in a furnace and fused by electricity. The result was that they threw down prismatic crystals composed of pure corundum combined with carbon.

"The discoverer came to New York with these first crystals. Stepping into a diamond-cutter's laboratory he asked the cutter in charge what his crystal was. A series of tests developed that it would scratch a diamond. A diamond is pure carbon and the hardest natural thing in the world. He sold these crystals for more than he could have obtained for diamonds of the same weight. He had produced in a furnace material better than nature itself could make.

"So carborundum could never have been discovered by the dreamy inventor who worked alone. A great plant employing scores of men and costing a fortune in excess of the wildest anticipation of the seeker of bygone days was necessary. Years of work and thousands of dollars had to be expended to produce a few crystals that one could drop into the end of a goose quill. But these few crystals opened the way for an artificial abrasive that could be produced by the millions of pounds cheaply and quickly."

The Fittest Occupation.

Any observing person who enjoys watching people working at the various occupations, trades and professions that are carried on in every town and rural district of this great country is likely to wish that some means could be invented to transfer the misplaced workers into the positions mother nature intended them to fill. A little observation on the part of parents would prevent many mistakes that result in failures of life's work by putting young men or young women into occupations for which they have no natural ability whatever.

The ordinary American mother looks with horror upon all lines of occupation that requires their offspring to engage in manual labor with the result that clerkships and genteel lines of work are overcrowded while positions calling for manipulative skill are unsought and looked down upon. When a boy of 13 or 14 years of age displays a bent towards any line of study, investigation, invention or practical work he should be encouraged to follow his bent for in that line he will become a master. The call is constantly growing for people to follow expert labor in building houses, making machinery, shoeing horses, running steam engines, making clothes and other mechanical operations. Playing on the piano or playing baseball may be much more attractive to young people than working at useful and livelihood making occupations; but it is the duty of sensible parents to see that their children do not fall into starvation lines of work merely because such may be their foolish choice.

We do not mean to depreciate all occupations that are not sure bread winners for we are well aware that certain lines of artistic training often lead the way to important positions. Artistic study is of advantage in the general development of a child, and if he displays no other learnings, art culture may open the way to valuable practical work. For several years, beginning towards the end of last century, a silly sentiment arose that the work of crafts and trades was vulgar, unworthy of being followed by mother's darlings who might be degraded by soiled hands. Fortunately that line of distorted taste has passed away and the trend of people having to earn their own livelihood is towards handicrafts and trades, the ambitions to follow commercial careers having abated under the depression of few prizes to distribute among the numerous claimants.

No matter what line of work a young man or a young woman is destined to follow, it is of supreme importance that they should be guided into the line for which they are best fitted by their creator.

Against Consolidation.

One of the movements that bloom perennially at the railroad mechanical conventions is the proposal to consolidate the Master Car Builders' and the Railway Master Mechanics' associations so that the business relating to changes, management and improvements proposed on cars and locomotives may be supervised by the same officials. Some people see hopeful signs of progress in that movement, but it does not seem to prosper, for scarcely anything was said about it at the 1913 convention, and has displayed but small vitality for several years. Yet there are a few members whose enthusiasm for consolidation never dies and we heard their desires whispered at both the recent conventions. When the real sentiment of the vast majority of the members is reached there is found to be positive wish that no change should be made and time seems only to make this decision more positive.

Toilers and Triflers.

Many ministers of the gospel have very little sympathy with the millions of toilers who earn a livelihood by the sweat of their brows, but preachers with humane sentiments are heard from occasionally. Dr. Taylor, of Schenectady, recently preached a sermon from which we glean the following paragraphs:

"Our political problems are all secondary to the great industrial problem. The old conditions have vanished; the old close relationship between employer and employe. The right to dismiss an employe without cause is no longer recognized as a legal right. It never was a moral right. The great disparity between the reward of the brains that direct and of the hands that accomplish is being swept away.

"One would almost wish there were no industrial mutterings and discontent. But the fact remains that there is not only plenty of it but that a great deal of it is apparently justifiable. There is no desire to ignore that part of it which is senseless and arrogant, such as we have witnessed in recent outbreaks in industrial centers. But much of this is aggravated by the sickening spectacle of the lavish luxuriance of many who will not work and who are simply enjoying the fruits of other men's toil.

"The national sore spots are not only in such places as Lowell and Lawrence and Paterson and the East Side, but we find them also in Lenox and Newport and Fifth avenue and other social centers, where side by side, with a true and distinct American culture, reek the vulgarities of the easily rich; where ill-gotten wealth is squandered lavishly and ostentatiously; where more is spent upon a monkey or a puppy in one day than would clothe and feed ten American children in one week; where brainless fools and vulgarly-habited women hold high revelry.

"'Why should these people who scorn to work have all that to waste while I have not enough to buy bread and clothes for my children?' is the laboring man's logical cry. And, mind you, we cannot answer it in these days by saying, 'Because it is their own and they have a right to do as they see fit.' They have no such right.

"They have no right to corrupt their fellows, to debauch the self-respect of their servants, to increase the cost of living for those who cannot spend as they can spend. The secret of the high cost of living lies in this senseless waste for which they are largely responsible. The danger to our civilization lies in these two un-American extremes of life, each of which seems determined to outdo the other in arrogance and bitterness; those who wish to possess without working for it, and those who do possess without having had to work for it." Both are bad, and should be abolished.

New Switchers for the C. & N. W. Ry. and C., B. & Q. R. R.

It is of importance to observe that the application of superheaters to a number of switching locomotives recently built, marks an interesting step in the development of this class of engine. It is found in practice, that the advantages resulting from the use of superheated steam in road service, are realized also in switching service. There is considerable economy in fuel and water consumption, and hence with a tender of given size it is not necessary for the superheater locomotive to run to the fuel bin and water tank as often as is the case when using saturated steam. Valuable time is saved in this way. Furthermore, the superheater, by reducing the demands made upon the boiler, is of assistance in suppressing smoke—an important advantage in yard work.

SUPERHEATER SWITCHER FOR THE CHICAGO AND NORTHWESTERN RAILWAY.

R. Quayle, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The accompanying illustrations represent two designs of superheater switching locomotives recently built by the Baldwin Locomotive Works. The locomotive for the Chicago & Northwestern is one of 29 completed for that road, and five similar locomotives have been built for the Chicago, St. Paul, Minneapolis & Omaha Ry. Fifty locomotives, as illustrated, have been constructed for the Chicago, Burlington & Quincy Railroad.

SUPERHEATER SWITCHER FOR THE CHICAGO, BURLINGTON AND QUINCY RAILROAD.

J. W. Cyr, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The locomotives for the Chicago & North Western are equipped with Schmidt superheaters, and exert a tractive force of 23,400 pounds. The boiler has a straight top, with a long firebox placed above the frames. The firebox has corrugated side sheets, and the front end of the crown is supported by four rows of flexible bolts. The furnace equipment includes a steam jet smoke-burner, and also a brick arch supported on two water tubes. With the help of these devices, high volatile coal can be burned with very little smoke. The superheater is composed of 16 elements and it is of the top header type with outside steam pipes. The smokebox is fitted with the Slater front end arrangement, as developed on the North Western.

The cylinders of these locomotives are

lined with steeled cast-iron bushings, 7/8-in. thick; and the steam distribution is controlled by 11 inch piston valves which are driven by Baker gear. The main frames are of cast steel, with double front rails of forged iron. The driving pedestals are fitted with Markel removable side plates of cold rolled, case hardened steel, and flangeless shoes and wedges of brass. The driving boxes are also of the Markel design, with removable bearings and side motion plates. These devices have been developed and used with great success on this road.

The general dimensions are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 18 ins. x 24 ins.; valves, balanced piston.

Boiler.—Type, straight; material, steel; diameter, 60⅛ ins.; thickness of sheets, 9/16-in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 82 ins.; width, 38⅜ ins.; depth, front, 70 ins.; depth, back, 67 ins.; thickness of sheets, sides, ⅜-in.; back, ⅜-in.; crown, ⅜-in.; tube, ½-in.

Water Space.—Front, 4 ins.; sides, 4 ins.; back, 4 ins.

Tubes.—Material, steel; diameter, 5½ x 2 ins.; thickness, 5½ ins. No. 9 W. G.; 2 ins., No. 11 W. G.; number, 5½ ins., 16; 2 ins., 106; length, 11 ft. 6 ins.

Heating Surface.—Firebox, 128 sq. ft.; tubes, 897 sq. ft.; firebrick tubes, 12 sq. ft.; total, 1,037 sq. ft.; grate area, 21.8 sq. ft.

Driving Wheels.—Diameter, outside, 51 ins.; center, 44 ins.; journals, 8 x 10 ins.

Wheel Base.—Driving, 11 ft.; rigid, 11 ft.; total engine, 11 ft.; total engine and tender, 41 ft. 9 ins.

Weight.—On driving wheels, 129,800 lbs.; total engine, 129,800 lbs.; total engine and tender, about 240,000 lbs.

Tender.—Wheels, number, 8; diameter, 33 ins.; journals, 5 x 9 ins.; tank capacity, 5,500 gals.; fuel capacity, 8 tons; service, switching.

Engine equipped with Schmidt superheater. Superheating surface, 206 sq ft.

The locomotive for the Chicago, Burlington & Quincy Railroad is one of fifty recently placed in service. The tractive force exerted is 28,300 pounds. The boiler used in this design has a straight top also, but the firebox is wide, and is placed back of the driving wheels. The superheater is of the Emerson type, with 18 elements. The steam distribution is controlled by 10-inch piston valves, which are driven by the Stephenson link motion, and are set line-and-line in full gear. This is a most satisfactory setting for a locomotive which must frequently start under heavy load.

These are both highly developed types of switching locomotives, specially designed to meet the conditions on their respective roads. The principal dimensions are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 20 x 24 ins.; valves, balanced piston.

Boiler.—Type, straight; material, steel; diameter, 60 ins.; thickness of sheets, 9/16-in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 72 ins.; width, 54¼ ins.; depth, 58½ ins.; thickness of sheets, sides, ⅜-in.; back, ⅜-in.; crown, ⅜-in.; tube, ½-in.

Water Space.—Front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

Tubes.—Material, steel; diameter, 5½ and 2¼ ins.; diameter, 5½ ins., No. 9 W. G.; 2¼ ins., No. 11 W. G.; number, 5½ ins., 18; 2¼ ins., 98; length, 14 ft. 6 ins.

Heating Surface.—Firebox, 105 sq. ft.; tubes, 1,206 sq. ft.; total, 1,311 sq. ft.; grate area, 27.1 sq. ft.

Driving Wheels.—Diameter, outside, 52 ins.; center, 44 ins.; journals, 9 x 10 ins.

Wheel Base.—Driving, 10 ft. 10 ins.; rigid, 10 ft. 10 ins.; total engine, 10 ft. 10 ins.; total engine and tender, 45 ft. 4 ins.

Weight.—On driving wheels, 130,100 lbs.; total engine, 130,100 lbs.; total engine and tender, about 250,000 lbs.

Tender.—Wheels, number, 8; diameter, 33 ins.; journals, 5 x 9 ins.; tank capacity, 6,000 gals.; fuel, capacity, 8 tons; service, switching.

Engine equipped with Emerson superheater. Superheating surface, 338 sq. ft.

LATE SPRING IN THE NORTHWEST.

Canadian Railway Extensions.

The Canadian Northern is already 3,750 miles long, stretching over an immense territory, but the highly enterprising vice president, Sir Donald Mann, a Scot, who does not recognize the expression "fail," is determined to make the line much farther reaching before the snow ends the enterprise for the year. According to the predictions of this energetic railway builder, the Canadian Northern Railway extension from the Middle West will be completed to Montreal within six months. The chief cause of the delay was that 17 steel bridges had to be built between the mountains and Kamloops. Sir Donald expects, however, that the Canadian Northern will have a share in moving the grain crop east over its own line at the close of navigation in the autumn. The company will use both St. John and Halifax as Atlantic coast outlets, reaching these ports by the Intercolonial Railway.

Timber Famine Coming.

Supplying railway ties makes a tremendous drain upon the timber resources of the North American Continent and some radical remedy must be provided or the countries will soon be compelled to endure a wood famine such as no other country ever experienced. Great hopes were at one time cherished that steel ties would check the drainage of timber, but the hopes have not been realized. If the existing consumption of timber should continue those familiar with conditions estimate that in ten years the United States will be drained of all its valuable timber.

An address was lately delivered by Dean Ferguson, of the Department of Forestry. He said that this country has already consumed more than half of its original timber supply and that the remainder is being cut three times as fast as it grows.

In ten years, at the present rate, there will be no marketable timber in Pennsylvania, said Professor Ferguson. He used per capita figures to indicate the profligacy of the nation in this particular.

"Here," he said, "the per capita consumption of timber is 260 cubic feet annually. In Germany the rate is 37 cubic feet and in France 25. At the same time there is an immense unchecked waste due to pest and fire."

The speaker referred to the appalling economic waste represented by the 660 square miles of land rendered barren in this State by the indiscriminate cutting of timber. The condition not only represents an economic loss, he said, but also affects the climate and the water supply and breeds conditions which favor destructive floods.

Private interests must be depended on, Professor Ferguson said, to replant the denuded areas. This they will not do until they are assured of proper protection from fire and exemption from taxation upon growing timber in which capital may be invested for years without the return of a penny.

Railway Construction in Africa.

The Benguella Railroad, which has as its goal the Katanga copper belt, in the extreme southern section of the Belgian Congo, is, as projected, about 1,225 miles long. Of this, 425 miles, from the Katanga copper belt to the Belgian Congo frontier, is to be built by Belgian capital. The Atlantic end of this railroad was opened to traffic on September 17, 1912, for 270 miles from Lobita Bay. By July, 1913, it should reach Bihi and have 325 miles of railroad under operation. Upon arrival at Huambo, a little over one mile above sea-level, the most difficult part of the line will have been finished.

Air Brake Department

Control Valve Test Rack.

In the 1911 issues of RAILWAY AND LOCOMOTIVE ENGINEERING we described and illustrated the "P. C." equipment for passenger cars, and at the present time we have a view of the Westinghouse control valve test rack, which is to determine the fitness of the No. 3E and No. 3D control valves for service.

Our readers will understand that the standard code of tests accompanies an installation of the test rack and this is merely to give a general idea of the test requirements and to be of some assistance to the inspector.

The test measures up, in accuracy, to that to which triple valves and distributing valves are subjected and is made with the same differential valve and type of brake valve, and while some racks are designed for testing both triple and control valves, the present rack is exclusively for control valves.

The portion of the test it is desired to comment upon is the method of determining the source of leakage that will occur at the various exhaust ports when certain positions of the valves become defective from wear or neglect. The 3-E control valve is also manufactured with a common exhaust outlet, but for our purpose we refer to the valve which has been shown in this department.

Disregarding the numbers of any of the cocks or any positions of the test rack operating valves, when the valve is placed in position on the rack or when in service on a car, leakage from any of the ports is traced in the following manner:

Charged to the maximum pressure, control valve in release position, a leaky equalizing slide valve, a leaky release slide valve, a leaky graduating valve or a leaky direct and graduated release cap gasket would cause a "blow" or escape of air from the application chamber exhaust port. To determine part at fault usually requires an examination of the valves mentioned.

A leak from the emergency piston exhaust could be from either the release slide valve, the graduating valve, the equalizing slide valve, or from leakage past, the seal of the equalizing piston or past the seal of the small emergency piston.

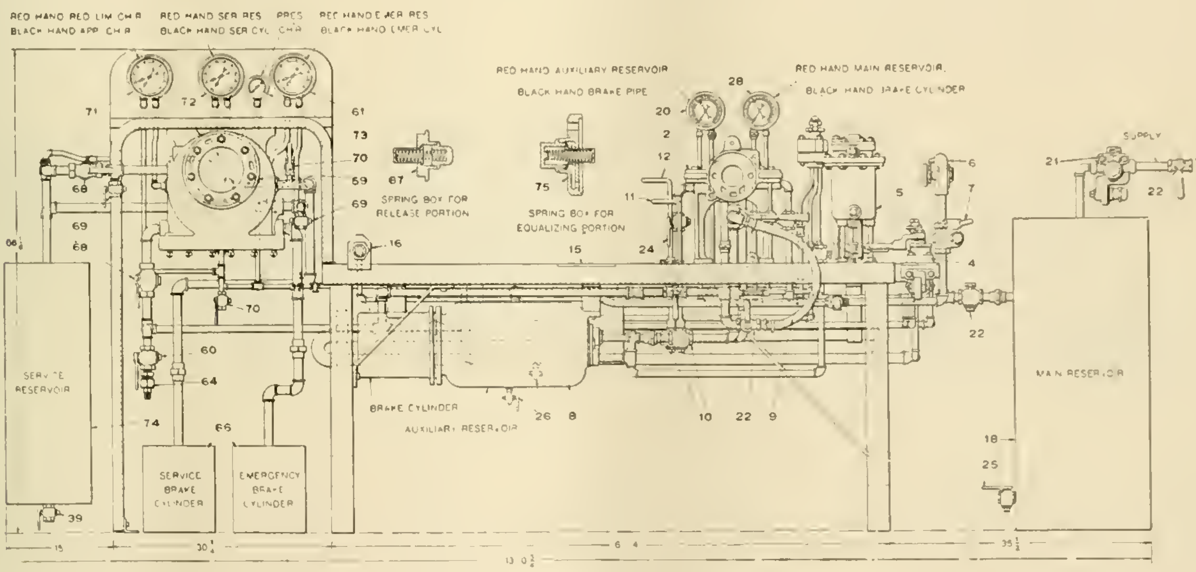
As a preliminary test to locate the source of this leak a 10-lb. reduction can be made, and if there is no leakage when in service position it is probable that the leak is from the seal or seat of the small emergency piston or the small end of the equalizing piston.

A leaky equalizing slide valve, graduating valve, or a leak into the reduction chamber from the cover of the application valve would cause a blow at the reduction limiting chamber exhaust. In this event a 10-lb. brake pipe reduction, moving the valve to application position should lap the exhaust port and stop the blow if the application portion is at fault, but if the leakage continues with the control valve in application position it indicates that the equalizing slide valve or graduating valve is at fault.

A blow from the service cylinder exhaust will be caused by a leaky application valve or a leaky emergency slide valve, and to determine the source of the blow a 10-lb. reduction should cause the leakage to cease if it is from the application portion, while if it continues it is from the emergency slide valve.

A leak from the emergency cylinder exhaust port is caused by a leaky emergency slide valve or by a leak past the cap nut of the quick-action closing valve.

A blow at the quick-action exhaust port is caused by a leaky rubber seated quick-action valve.



WESTINGHOUSE CONTROL VALVE TEST RACK.

The foregoing has reference to blows found when the control valve is in release position. Now, after an application of the brake some other blows or leaks may manifest themselves, notably among them is the exhaust valve of the application portion, which is not under pressure while the valve is in release position, hence, as a general proposition, after a service application of the brake a leak from the service cylinder exhaust port is caused by a leaky exhaust valve of the application portion.

A leak from the application chamber exhaust is then from a leaky release slide valve.

A leak from the emergency piston exhaust is, at this time, from a leaky release slide or graduating valve, and a blow at the reduction limiting chamber exhaust

could be caused by a leaky equalizing slide valve or graduating valve or by a leaky cap nut of the application portion. On the test rack a suitable bleed cock is provided which, if opened, will eliminate the leaky cap nut, which would leak brake cylinder pressure into the reduction limiting chamber, but if the blow should continue with the cock open, it indicates the leaky equalizing slide or graduating valve. At this time a blow at the emergency cylinder exhaust is from the emergency slide valve and a blow from the quick-action exhaust is from the rubber seated quick-action valve.

In over-reduction position, a blow at the reduction limiting chamber exhaust is from the leaky emergency reservoir check valve.

In emergency position a leak from the application chamber exhaust or the service cylinder exhaust is same as when in service position, but a leak from the emergency piston exhaust is at this time from the seal of the large emergency piston and a leak from the reduction limiting chamber exhaust indicates leaky equalizing slide or graduating valve leakage.

A leak from the emergency cylinder exhaust is now caused by a leaky emergency slide valve or a leaky piston packing leather of the application piston or by a leaky leather seal on the brake cylinder side of the application piston.

The source of the leak can best be located on the test rack, where, after a service application, the service reservoir and service brake cylinder can be drained from the application portion and application chamber pressure will force the application portion to emergency position, and if there is then a drop in application chamber pressure, it will denote packing leather leakage, but if the pressure is retained it indicates that the leather seal of the application portion is leaking.

A blow from the quick-action exhaust when in emergency position could be caused by a leak past the seal of the small closing valve, or it may be caused by leakage by the quick-action valve if any air pressure is retained in the brake pipe.

After an emergency application excessive friction on the quick-action piston may prevent a return of the quick action valve to its seat and thus cause a heavy blow when brake pipe pressure is restored.

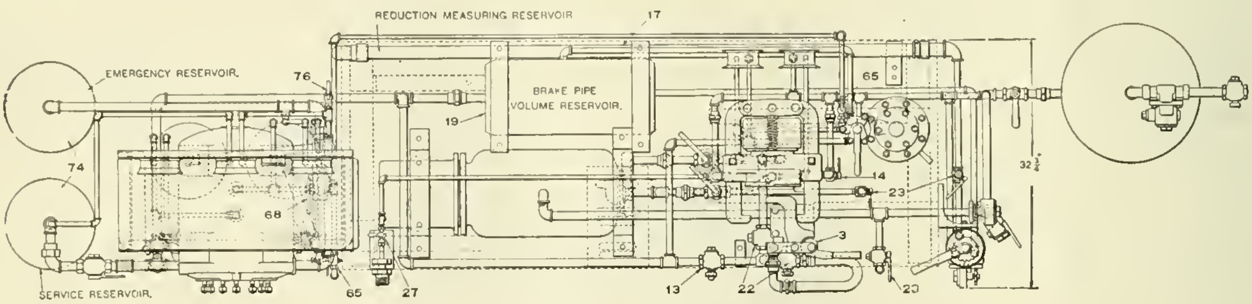
When any of these possible blows or any possible leakage is remedied the control valve must pass a number of tests, principally among them being the

Charging tests.
Service sensitive test.
Packing ring leakage test.
Release test.
Leakage into brake pipe.
Continuous service reduction to produce emergency.
Sensitiveness of application portion.
Time of release from application chamber.
Graduated release test.
Sensitiveness of charging valve.
Service port capacity test.

We cannot at this time explain in just what manner all the tests are made, but hope to do so in future issues, and for the present the reader should be careful to distinguish between the various exhaust ports while attempting to locate the source of blows before removing any of the parts, and facing the control valve, the ports on the left hand side are the service cylinder exhaust, the application chamber exhaust, the quick action exhaust and on the equalizing portion is the reduction limiting chamber exhaust, while on the right hand side the exhaust port on the reservoir is the emergency cylinder exhaust and the one on the equalizing portion is the emergency piston exhaust.

To the beginner this equipment seems to be very complicated and the diagrammatic views are somewhat formidable, but a little study will soon lead to an understanding of it and it is necessary as quite a large number of control valves are in interchange service and must be cared for as well as the triple valves.

The control valve is also used in electric service and control valves of the E 11 type are "electro-pneumatic," that is, operated by electricity, and these electrically operated air brakes will very soon be the standard for steam road passenger service. However, the new "universal" equipment will be the logical solution of the air pressure transmission problem in passenger service in the near future.



PLAN VIEW WESTINGHOUSE CONTROL VALVE TEST RACK.

Break-in-Two of Trains.

One of the most annoying and dangerous occurrences in modern railroad operation is the break-in-two of trains, and one of the most difficult problems is to locate the cause and place the responsibility.

This has become particularly acute in handling long freight trains, and in an effort to place before the members of the Air Brake Association a series of recommendations covering the successful handling of trains, inspection of draft gear and other factors entering into the subject, Mr. F. B. Farmer, an expert of the Westinghouse Company, who is well known to the air brake men of this country, through his work in the Brotherhood of Locomotive Firemen and Enginemen's magazine, has prepared a paper which we think has very completely covered this subject to date.

To appreciate the import of the recommendations necessitates a careful study of the paper, and in this issue we reprint a portion of the paper which leads up to the instructions governing the handling of freight trains.

Mr. Farmer deals with the earning capacity of the freight car and the cost of delays to freight trains and outlines a method of break-in-two investigations as applied in the case of several railroads that were desirous of preventing, so far as possible, the break-in-two of trains, not that all roads are not desirous of preventing it, but few are willing to go into the cause and effect deep enough to obtain the results or in other words this requires a co-operation that is sometimes difficult to secure.

The portion of the paper that we wish to place before our readers is that which relates to train handling and on this subject Mr. Farmer says:

"Draft rigging in fair to good condition is not *pulled* out. It is either *driven in* or *jerked out*, both implying a severe blow. The severity cannot be judged by any shock *felt* by those riding trains, particularly the engineer of a heavy locomotive. For a shock to be felt the speed must change suddenly and considerably. The amount of the instant reduction in speed of a modern freight locomotive necessary to cause a break-in-two, is too little to be

felt as the severe shock that it is to draft rigging. Engineers who do not understand this are prone to attribute resulting failures to the condition of the draft rigging instead of to their handling.

"Another over-worked explanation for draft gear failures is 'old defect.' Many of such should be called ancient defects. Not infrequently it is an *original* one in an old coupler. While allowance must be made for an old defect, yet the fact that its evident age did not result in failure before, asks why then? Would the failure have occurred with proper handling? Again, every 'old defect' not original with the part that failed was once a *new* defect, and if this bald statement is quite regularly accepted as a sufficient explanation little improvement need be expected.

"Records show, regarding break-in-twos with ordinary freight trains of from 1,700 to 2,400 tons, that 20 per cent. to 25 per cent. occur within five cars from the engine; about 40 per cent. between the engine and tenth car, and 60 per cent. to 65 per cent. between the engine and twentieth car, conclusive proof that it is the harsh *running out* or *pulling out* of slack at the head end that does most of the damage in train handling.

"As it is a false pride that prevents some engineers from *encouraging* the conductor to advise of any severe shocks to the rear of the train, the wise man will pocket his pride and get this information, appreciating that in no other way can he judge how to handle trains without damage toward the rear. This simple and commonplace suggestion is very important in good handling.

"Starting a freight train properly requires fundamentally that the engine be kept at a slow and uniform speed until the rear car is moving. The distance to accomplish this will vary. As the value of any rule on train handling is measured largely by its simplicity and freedom from exceptions, our instructions on starting freight trains are to keep the engine at a slow and uniform speed for two car lengths. This will prevent damaging the longest train, hence, will care for any shorter ones.

"Stopping properly will usually bunch the slack sufficiently for starting, but if slack has to be taken it should be either a foot or two or that of the entire train. Stalling in starting, taking the slack on part of the train and then trying to start is very bad practice. Almost unconsciously the engine is allowed to gain such headway as to generally do damage when the stretched portion of the train is reached. The writer once saw a "William" goat fail in trying to pull his stake pin loose. He then took a run at it and on reaching the end of his rope turned over on his back quite abruptly. Repeating this pulled the pin. Goats may be built for handling the slack as he did. Cars are not. Don't be the goat.

"Mr. G. B. Pierce has had considerable experience running a Mallet pusher. Stalled one night with over-tonnage he arranged with the others of the crew to try a new plan of starting. The head man was to do all he could and then keep his throttle open moderately, but prepared to ease off as much as necessary when he was started so as to avoid a lurch. Mr. Pierce took as much slack as deemed necessary, then started carefully, simply. The results proved so satisfactory that the method was repeated where necessary with other trains and is now the standard on that road. Its logic is apparent, as the helper cannot drive the slack into the head end and the two engineers are more certain to work together. Also draft rigging will stand more thrust than pull.

"Running, including slowing but not stopping, demands first that the engineer know how the curvature and change of grades will affect the train slack and that he make such use of steam, sand and the air brakes, including the independent engine brake, as to prevent any severe shocks. Instances are known where changes of grade caused the slack to run in harshly from the rear and in spite of steam being used heavily to prevent. The remedy is to bunch the slack carefully with the independent brake just before reaching the point where it would otherwise run in heavily. It is always undesirable to shut off suddenly where steam is being used heavily, but particularly so at a point where the track conditions alone would cause the slack to run in.

"Stopping, like starting, is where much of the damage is done. Stopping long freight trains with the engine brakes only should generally be discouraged. Granted that it can be done with many advantages where conditions favor, as they frequently do, yet the fact is too often attested by trainmen, particularly those in the caboose, that it is abused. Some engineers either apply it too heavily, or, if light enough, do not wait long enough to get the slack in to the rear before applying harder. Again, this part may be done well, but the brake be held applied to the stop. Its power should always be reduced nearing the stop and completely released if on even a gently ascending grade. Otherwise, the compressed coupler springs will run the slack back fast enough to do damage. The only safe general recommendation is to use the train brakes when stopping with more than a few cars.

"Without the aid of electricity the head brakes must apply and release first. The K triple reduces the difference in time of application between the head and the rear brakes, but does not eliminate it. This difference in time of application runs the slack in while the reduction is taking place and runs it out when releasing. However, no harm will follow if the running of slack is not harsh. How the slack is, at the time of applying or releasing, is very important. To illustrate, assume a long train with empties behind loads, speed 10 m. p. h. and total reduction 8 pounds when starting to release the brakes. With sufficient time since the application was begun the brakes on the empties would run the slack out, but if the release were started just as the brake valve discharge ended, the slack would be in. The difference in shock from releasing where all conditions were alike but the slack should be obvious, yet this one difference is why those engineers who overlook it are prone to blame the brakes or the draft rigging for damage occurring where none followed where they did the same thing, as they see it, without harm.

"What to do and when to do it must follow answers to (1) how is the slack, and (2), considering the speed and possible compression of coupler springs (slack either in or out heavily), what effect will the contemplated brake action have on it? Also (3), what else can be done to neutralize any detrimental effect?

"Like the position of the slack, the effects of speed and brake pipe reduction are too little appreciated or considered. For example, where at the same speed it would be practicable to release after a reduction of 8 pounds, yet following one of 15 pounds could cause a severe shock, and after one of 25 pounds or more (over-reduction) it would be more severe. It is like lower speeds at the time of release where the reduction is the same.

"If you answer the question, "Why is releasing the brakes on a long train at low speed liable to cause a break-in-two?" (not K triples) by saying it is because the head brakes release first you have told a half-truth, and such is often equal to a misstatement. Of course, the head brakes release first, but they do also at higher speeds, *but the slower-releasing rear brakes do not hold as well at the higher speeds; hence, do not run the slack out as rapidly.* For the same reason the earlier application of head than of rear brakes will run the slack in gently at the higher speeds where it might do so harshly at low speed.

These indisputable facts should make clear why, in stopping, but two reductions should be made, the initial one and the other within forty feet of stop. At the higher speeds the slack will run in and out gently. Having adjusted itself to suit the conditions it should not be disturbed by farther reductions until the second one directed. If the slack is then out it starts it in, but too late for it to run out again; if in already this reduction will still do no harm. By not exceeding an initial reduction of 12 lbs. (less with lower speeds) the slack action is more gentle and the final reduction will then be effective. This would not take place in the manner described if the initial reduction and leakage equalled or exceeded 20 lbs. when the final reduction was begun."

Steel Hopper Cars on the Birmingham Southern Railway.

A lot of eighty hopper cars of seventy tons capacity was recently received by the Birmingham Southern Railroad. These cars were designed and built by the Pressed Steel Car Company and a description of them will, no doubt, be of considerable interest at this time when the various railroads of the country are so seriously considering the use of larger equipment with the view of reducing the cost of transportation and maintenance.

It will be noted from the accompanying illustration that the Birmingham Southern car has coke racks extending entirely around the sides and ends, these being made of 2½ ins. x 2½ ins. x ¼ in. angles, but cars of this kind can, of course, be built with solid sides and ends, in fact, some of the railroads have purchased in the last few years a great many cars of this general type for the transportation of coke, the bodies being made sufficiently strong so that if desired they may later on be equipped with seventy-ton trucks.

The weight of the Birmingham Southern car is 58,600 lbs., 38,700 lbs. being in the body and 19,900 lbs. in the trucks. This is several thousand pounds heavier than would ordinarily be necessary for a seventy-ton car of ample strength, but these cars have been built to withstand very severe service. The cars have a capacity level full of 2,840 cu. ft. and with 10-inch average heap of 3,157 cu. ft. The ratio of paying load to total weight of loaded car is 72½ per cent.

The general dimensions of the car are as follows:

Length over striking plates	41 ft. 5 ins.
Length over end sills	41 ft. 3½ ins.
Length inside of car	40 ft. 0 ins.
Distance from center to center of trucks	32 ft. 0 ins.
Width over side stakes	10 ft. 1⅝ ins.
Width inside of body	9 ft. 6 ins.
Height from rail to top of coke racks	12 ft. 0½ ins.
Height from rail to top of brake mast	12 ft. 9 ins.
Length of drop doors in clear, about	3 ft. 6⅞ ins.
Width of drop doors in clear, about	3 ft. 4¾ ins.

The cars are equipped with sixteen drop doors operated by the "Lind" door gear, which is self-locking, and when the doors are closed the accidental discharge of lading is impossible. The total door area is 97 square feet. The trucks are the arch bar type, with 6 ft. x 11 in. journals, equipped with Reliance truss type bolsters, pressed channel type brake beams, rolled steel wheels and adjustable type side bearings. The safety appliances are applied in accordance with Interstate Commerce Commission requirements. The air brakes are Westinghouse KD-1012 equipment and the cars are equipped with Westinghouse Farlow draft gear.

These cars are very highly spoken of by officials and others.

SEVENTY-TON QUADRUPLE HOPPER CARS FOR THE BIRMINGHAM SOUTHERN RAILROAD.

Introduction of Illuminating Gas.

Illuminating gas was first made by William Murdock in 1792 and in 1802 he installed a gas plant for lighting the foundry of Boulton & Watts engine works. The introduction of gas for lighting cities began shortly afterward and made steady progress in the British Isles and on the continent of Europe. It was extended very slowly to the United States. David Melville, an enterprising Scot of Newport, R. I., in 1804 installed a gas lighting plant in the house where he lived and extended it to the street. He used a patented apparatus which he shortly afterward applied to lighting cotton mills and other factories.

The more enterprising towns in the United States began by slow degrees to adopt gas lighting for the streets, but in some quarters there was fierce opposition and appalling prejudice. In 1833 several hundred citizens of Philadelphia signed a petition to the common council protesting against the introduction of illuminating gas into the city. They considered it, they said, a "most inexpedient, offensive and dangerous mode of lighting." They might have added, in accordance with distinguished opinion of today, that gas was to be condemned because it was not used by the revolutionary fathers.

Our Debt to the Horse.

Indications are that in a few years mechanical appliances will make the horse a very scarce animal. But the horse has performed services to man and to civilization greater than any other animal except perhaps the cow. The horse was connected with the ideals no less than with the realities of the phase in human history that was called after him—the age of chivalry. The mental consequences of the partnership between man and that noble beast were not less far reaching than the physical. There are a hundred types of human character, some of them of the highest, in the making of which the horse counts for nothing, but this type, this figure of the very perfect gentle knight, cannot be imagined in a horseless world. We hear of what man taught animals, but less of what animals taught man. In the unity of emotion between horse and rider something is exchanged. Even the epithets which it is natural to apply to the knightly hero, one and all fit his steed.

Electrical Department

Individual Paper on Maintenance of Electric Equipment.

By Mr. C. H. Quereau.

It is the intention not to stray into the pastures of the electrical engineer or indulge in speculations as to the advisability of electrifying steam railroads or attempt arguments in defense of any particular system, single-phase, three-phase or direct current. Such discussions have already been vigorously carried one, with more or less success and satisfaction, by those much better equipped for such contests than the writer. As a result, noncombatants have reached the practically unanimous conclusion that "Time alone will settle the case."

We all recognize the fact that several important steam railroads have, to a limited extent, replaced steam locomotives with electric locomotives and multiple-unit cars; and that their successful operation for five or six years and the experience gained during this time make the subject of the maintenance of electric equipment a live one. The fact that at least six American steam railroads are now using electricity for motive power purposes and the recent announcements of plans for extensive electrification of main lines on western steam railroads suggest the thought that almost any steam motive power organization may be called upon at an early date to maintain electric motive power and should make this subject of interest to all steam motive power men.

The word electricity naturally raises in the mind of a steam motive power man a suggestion of mystery, something he knows little or nothing about, and, what is worse, he is very apt to conclude he is "too old to learn." It is the object of this paper to try to show there is no more mystery about electricity than about water, steam, coal or other gifts of nature about which motive-power men have enough knowledge and familiarity to successfully manage their work; if possible, to remove the natural, but useless, fear of the subject which most of us have.

Until about seven years ago, I had no practical knowledge of electricity or experience with electrical apparatus, having held the positions of Engineer of Tests, Division Master Mechanic, Superintendent of Shops and Assistant Superintendent of Motive Power with steam railroads. This statement is made for the purpose of showing that the point of view of the paper is that of a steam motive-power man and with the hope it will make what follows more convincing than otherwise would be the case.

When asked to take the position of Superintendent of Electric Equipment, my first and very strong impulse was to decline because of lack of electrical experience, nor did the statement that all the expert electrical talent necessary would be supplied entirely remove the dread of entering the—to me—mysterious and untried field of electric traction. The assurance of the head of the railway department of an important manufacturer of electrical apparatus that at least seventy-five per cent. of the necessary training was supplied by experience in mechanical lines, did little more than somewhat reduce the distrust and the feeling that the field of electric traction was full of pitfalls and blind alleys. The experience of a few years has shown that the electrical expert was conservative and that at least ninety per cent. of the problems of maintenance to be solved and the faults to be remedied can be successfully worked out by a good mechanic, with a very limited electrical knowledge, who has had experience in the motive-power department of steam railroads.

To those acquainted with the men who are responsible for the maintenance of electric equipment—whether on trolley, interurban or steam railroad lines—it is a matter of common knowledge that those Master Mechanics, General Foremen and Mechanics who have been trained in the Motive Power Departments of steam railroads have somewhat the advantage of those who have not. I have in mind a western mechanic and general foreman whose experience with electric equipment was limited to six months as electric inspectors' helpers, who are eminently successful in maintaining electric equipment. In the case of steam railroads which are electrified, there are decided advantages in using men already in the organization whose characteristics are known, who are familiar with steam railroad policy, methods and requirements and such a plan removes all ground for the possible feeling that electrification will crowd out of their positions men who have served the railroad faithfully and satisfactorily for years. Some knowledge of electricity for such men is certainly necessary, but is very elementary and simple, preferably practical rather than theoretical, and can be acquired in such a short time that the advantages of using men for the maintenance of electric equipment who are already in the steam motive power department very decidedly outweigh the disadvantages due to lack of an extended knowledge of electrical apparatus. This conclusion has been reached after six years' experience in an electric equipment maintenance department on a steam railroad.

I am inclined to believe the greatest bugaboo for the steam motive-power man, when considering electrical matters, is the fact that he is not familiar with electrical terms and therefore imagines the whole subject is difficult. When the uninitiated hears or reads of volts, amperes, watts and kilowatts, circuit breakers, contractors and other electrical terms, he finds these words as meaningless as so much Choctaw. As a consequence, he gets no real information or adequate conception of the subject discussed and, perhaps naturally, concludes it must be beyond his powers and altogether mysterious. A little reflection will show him that at one time he was equally ignorant about such commonplace matters as hydrostatic pressure, steam consumption, horse-power, air brakes and superheaters, and that in all probability it would puzzle him, after years of practical use, to accurately define these terms, or even explain to a visitor from Mars what a foot really is, though for all practical purposes he knows each of them thoroughly and never imagines his inability to define technically the words he uses almost hourly is any handicap in successfully holding his job.

The volt is defined as "The practical unit of electromotive force which will cause unit current to be established in a circuit of unit resistance," but for all practical purposes may be considered as the unit for expressing the pressure or tension of an electric current, just as the pound is the unit used in expressing boiler pressure.

There is no doubt arising in the mind of anyone as to the meaning of the sentence, "The boiler carries a pressure of 100 pounds," nor is it necessary to be precise and add, "per square inch," because constant use has made us familiar with the meaning of the statement without looking in a book or stopping to think. We know that, other conditions remaining constant, steam at a pressure of 200 pounds will do twice the work that steam at 100 pounds pressure will. In the same way, a little practice will enable us to understand offhand there is twice the power in a 200-volt current there is in a 100-volt current, because the former has twice the electric pressure of the latter.

When we become familiar with the fact that the usual voltage of the electricity used about the home for lighting purposes is 110 and that the usual voltage for trolley and interurban, as well as multiple-unit, electric cars, varies from 500 to 600, we have a working basis from which to understand the statement that a transmission line is designed for 11,000 volts and a very large part of the wonder and mystery disappears.

With the above statements thoroughly fixed in our minds by constant use, if we read that the Chicago, Milwaukee & Puget Sound Railway is planning to electrify several hundred miles of its lines, using a voltage of 2,400, instead of wishing we had learned something of electricity when we were younger, we understand they are considering the use of an operating current having a voltage or pressure four times that which is usual.

The ampere is defined as "the practical unit of current and represents that value of current which will cause the electrolytic deposition of silver at the rate of 0.001118 grams per second." For everyday use, we may think of the ampere as the unit for measuring the quantity of electricity used or available, just as we speak of pounds of steam or gallons of water, and will know at once that an electric motor using 200 amperes of 600-volt current has twice the power of one using 100 amperes of current at the same voltage, or half the power of a motor using 400 amperes and a voltage of 600.

The watt is the unit of electric power and, for all practical purposes, is the product of the pressure, or voltage, by the quantity or amperes. For instance, the power of a current of 600 volts and 250 amperes is $600 \times 250 = 150{,}000$ watts. The watt in electric power matters is used in the same way that the term horse-power is in connection with steam power. It is reasonable to believe that anyone who can understandingly use the word horse-power in speaking of steam motive power can become accustomed to the intelligent use of the term watt, and when he learns that 746 watts are equal to a horse-power, can, with a little practice, compare the rated power of an electric motor or generator and a steam engine.

A kilowatt is simply a thousand watts and the term is used only for convenience In the preceding paragraph mention was made of an electric current having a power of 150,000 watts. This is usually referred to as a current of 150 kilowatts, or simply 150 k.w. From what has been said, it is evident a kilowatt is almost exactly equivalent to one and one-third horsepower and a 150 k.w. current equals practically 200 horse-power.

The terms watt-hour and kilowatt-hour are used in connection with electricity just as horse-power-hour is used in steam motive power discussions and means electric power of a watt or k.w. used, or available, for an hour.

The ohm is the unit expressing the resistance of a conductor to the flow of electric current and "represents the resistance of a column of pure mercury 106.3 centimeters long, of uniform cross-section and weighing 14.451 grams, at a temperature of zero degrees, centigrade."

It will take but little practice to understand the statement that a conductor having a resistance of 5 ohms will carry twice the current that a circuit having 10 ohms resistance will, or half the current a circuit having 2½ ohms resistance will carry, assuming that the voltage is the same in each case.

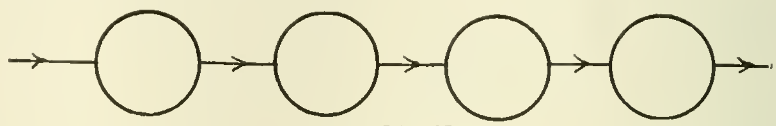
I have previously stated that "Some little knowledge of electricity is certainly necessary, but is very elementary and simple, preferably practical rather than theoretical." In this connection it should not be forgotten that this paper relates to the maintenance and is not concerned with the design of electric equipment. Experience has shown that the graduate in electrical course who is employed in maintaining electric apparatus is apt to require wiring diagrams and blueprints showing the circuits and relations of the apparatus, while the inspector whose training has been wholly practical soon learns by precept and practice that a given symptom is caused by a given defect and does not find it necessary to trace the intermediate steps, but goes at once to the seat of the trouble and removes the cause.

For instance, when an electric locomotive loses power when the motors are operated in series parallel, after having operated satisfactorily in series, the embryo electrical engineer is prone to waste time in hunting up wiring diagrams and tracing circuits, while the inspector whose knowledge has been acquired by practical experience knows that either a certain fuse has blown because of an overload, or a certain contactor has failed to operate properly and at once applies the necessary remedy.

It would be unwise to assume from the foregoing that an elementary knowledge of electricity and the ability to read wiring diagram blue-prints are undesirable or unnecessary to anyone employed in the maintenance of electric equipment. Such knowledge is both desirable and necessary, just as much as for steam equipment, but no more. The point is that the average mechanic, without previous electrical experience, does not require any great amount of electrical knowledge in order to successfully compete with an electrician in maintaining electric motive power.

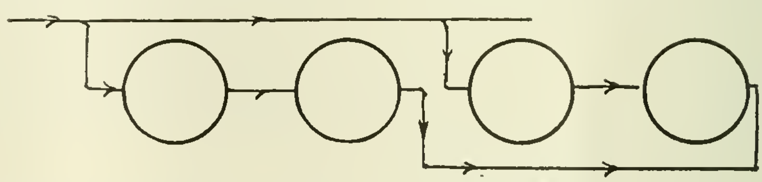
The average nontechnical reader has no doubt been mystified by the terms "series" and "series-parallel" and figuratively thrown up his hands. If to these is added "full parallel" he is probably down and out, but for one who is willing to try, their meaning is as plain and easy to understand as the terms "simple" and "compound" or "mallet" applied to steam locomotives.

Most electric locomotives have as many as four motors. When the electric current passes through these motors one after another, as shown in the accompanying diagram, the motors are said to operate in series, the circles representing the motors, the lines with arrow points representing the path of the electric current.



SERIES.

When the circuits are arranged so that the current passes through two groups of motors, each group consisting of two motors, they are said to be operating in series-parallel, or series-multiple; that is, two motors are operating in series in each of the two groups, while the two groups of motors are operating in parallel, or multiple; the current supplied to one group of motors flowing parallel to the current supplied to the other group.



SERIES—PARALLEL, OR SERIES—MULTIPLE.

If now each of the four motors receives its supply of electricity direct, that is, without flowing through any other motor, the motors are said to operate in full parallel, or simply in parallel, the current to and through each motor flowing parallel to that of each of the other motors.

It will not be surprising if some reader is unable to understand the diagrams representing the different groupings of motors. They will probably be readily understood if the circles are supposed to represent water motors—water turbines, for instance—and the lines with arrow points are assumed to be a diagram of the water pipes, the arrows indicating the direction of flow.

This brings to mind the fact that the most helpful illustration to an understand-

ing of electric circuits and diagrams is to think of them as showing a water system. In place of the electric motor put a water motor, and consider the wiring plans as showing the distribution and connections of water pipes. The analogy can be carried farther; the water pressure stands for the voltage and the pounds or gallons of water flowing or available, the amperage of electric current; the horse-power hours of a water turbine are the equivalent of the kilowatt-hours or horse-power hours of an electric motor or generator.

It is not the intention to write an elementary treatise on electricity or electric apparatus nor promote a dictionary of electrical terms with non-technical definitions, but simply to give assurance to the average motive-power man that his experience, together with a very elementary electrical knowledge, qualifies him for the maintenance of electric equipment. In addition, it is hoped the bugaboo of imaginary mystery surrounding electrical matters will lose most of its terrors

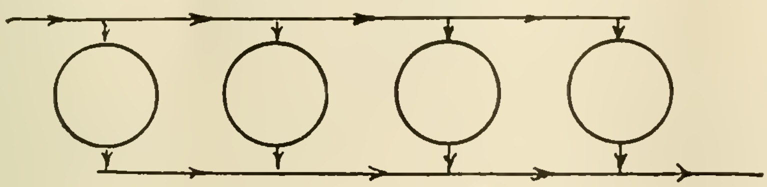
In addition to the cloud of mystery, there is quite generally an exaggerated fear of electricity in the minds of the uninitiated—a fear of personal injury—that prevents them seriously considering the advantages and wider opportunities in the electric-equipment department. That there are advantages and wider opportunities there is little room for doubt. This fear is doubtless in part due to the fact that lightning is generally known to be of electrical origin and to the further fact that electricity cannot be seen, as steam and fire can.

A child is not encouraged to play with matches or fire in any form, nor anyone without experience to assume responsibility for steam apparatus. The same precautions used in connection with electric matters will assure as small a percentage of injuries and fatal accidents. Life insurance companies charge no higher premiums for men working about electric equipment than those employed in ordinary repair shops for steam equipment.

The fact is, if simple and inexpensive precautions are taken, there is no greater danger in working about electric than steam equipment. No one with ordinary sense and experience would think of putting his bare hand on the unprotected steam pipe of an injector, even though he cannot see the steam flowing through it. There is no greater danger in connection with electric circuits if the same common sense is used. This refers to 600-volt direct current and would possibly have to be modified for materially higher voltages, nor to high-tension lines where the hazard is undoubtedly greater.

The statement is occasionally made that an electric is a simpler machine than a steam locomotive. If this refers to ease of handling and operating or matters requiring the attention of the engine crew, such as injectors, steam pressure and water level, there is no possible doubt the statement is correct, but if it refers to the mechanical simplicity or number of adjustable or moving parts that must be inspected and kept in proper relation, the steam locomotive is very much the simpler. There is, however, this fundamental difference favoring the electric machine; that the moving parts of the control are of very light weight, easily accessible for inspection and repairs and not subjected to nearly as great wear as are the corresponding parts of a steam locomotive.

It will no doubt interest motive-power men to know that the shop arrangement and tools for maintaining electric equipment are not essentially different from those they are accustomed to in repairing steam locomotives, except, of course, the electric locomotive has no boiler or tender and it is necessary to provide facilities for rewinding armatures and field coils.



FULL PARALLEL, OR MULTIPLE.

The steam motive-power man will no doubt be much surprised when told the electric locomotive requires no shopping for a general overhauling, except for a general painting. This is made possible by having a stock of spare parts, permitting the removal of a defective part from a locomotive, the substitution of a repaired part and releasing the engine, the defective apparatus being repaired at leisure. For instance, a set of driving wheels needing tire turning are replaced by an extra set in good condition, this operation requiring not more than five hours with adequate drop pit facilities. Air compressors, controllers and contractors can be handled in the same way.

The steam locomotive cannot be maintained on this plan, as the boring of cylinders and resetting flues make it necessary to shop the engine, withdrawing it from service for a considerable length of time.

It is quite possible the foregoing statements of personal experience and opinions will not prove as convincing as the records made by an electric equipment maintenance department organized by and largely consisting of men whose earlier experience and training were obtained in the motive-power department of steam railroads. It seems reasonable common sense will conclude there can be no particular mystery or unusual danger in maintaining electric locomotives when the records for the year 1912, after five years' service, show a cost of less than 4 cents per mile and an average of 48,271 miles per train detention due to electrical apparatus, with a banner record of 249,423 miles (equivalent to ten times around the world), without a train detention due to the electrical equipment.

Safety First Movement.

The "safety first" campaign, which is not only humanitarian, but also largely financial in a reduction of the drain from damages awarded as a result of preventable accidents, has been carried out by a large part of the electric railways in the United States. Analyses of experts have proved conclusively that about 85 per cent. of accidents were due to carelessness or negligence of the injured, under the old conditions and before the inauguration of the "safety movement."

Electric Switchers.

Within the past few years the application of electric locomotives to many phases of industrial service has become very extensive. One of the many uses to which these locomotives have been put is for switching cars in private yards, etc., doing away with the fire hazard to the buildings and material in the vicinity. Another use is for mining. The Timber Butte Milling Company, Butte, Mont., has recently put into service a 40-ton Baldwin-Westinghouse electric locomotive. This locomotive is being used for hauling materials to and from the concentrator site.

Electric Supplies for Japan.

The shipment consisted of 25 freight cars loaded with machinery for Japan. It was consigned to Takata & Company, at Tokio, and is to be used in connection with the large water power development of the Inawashiro Hydro-Electric Power Company which is building a large plant about 145 miles from Tokio. The current will be generated at this point, and stepped up to 115,000 volts, which is the highest voltage ever used in Japan. From this point it will be transmitted to the city of Tokio where it will be used for furnishing light and power.

The shipment consisted of eight 4,000 kwt., and four 150 kwt. O. I. W. C. transformers, two motor generator sets, the remainder of the shipment being composed of switchboard material. The total weight of the shipment is 913,972 pounds, and was routed from Pittsburgh to Tacoma, by way of the Pennsylvania and Chicago, Milwaukee & St. Paul railroads. At Tacoma it will be reloaded on boats, and proceed thence to Japan.

Forty-seventh Annual Convention of the Master Car Builders' Association

When members of the Master Car Builders' Association looked over the program of business prepared for consideration at the forty-seventh convention the first impression made was that more than three days would be needed to get through the work. There were eight reports of standing committees arranged for, and reports from fifteen special committees, all of them important. By hard systematic efforts all the work was accomplished, making the forty-seventh convention one to be remembered.

The magnitude of the problems now facing the Master Car Builders' Association may be judged from the fact that one committee was appointed to prepare specifications for tests of steel truck sides and bolsters for cars of 50,000, 100,000 and 150,000 pounds capacity. As all the other parts of such cars must be made in proportion to the carrying capacity, there is a wonderful amount of details to be worked out. An unusual feature of the personnel of the committees is the number of members who are Pennsylvania Railroad officials, no less than twenty-four of them having been appointed to work on committees. This is certain to promote the character of the work performed, since the Pennsylvania Railroad Company possess exceptionally fine appliances for testing and making records of railroad machinery.

The first on the list was the Report of the Arbitration Committee, whose duty it is to consider complaints and settle them—performed a large volume of work during the year. Every complaint that comes before the Arbitration Committee is numbered and is referred to when any dispute of a similar character arises. During the past year the committee rendered decisions in Cases 881 to 917.

It used to be the case that individuals sent in most of the complaints for decision by the Arbitration Committee, but a change has now been made so that complaints are made by a committee of each of the railway clubs which greatly expedites the work. The clubs also take up the rules of interchange of cars, number by number, and recommend any changes which the members think desirable. For instance, when Rule 16 was reached the report stated:

The Missalic Club suggests adding: When making repairs to superstructure of cars, U. S. Safety Appliance Standards are to be provided as per Interstate Commerce Commission order of March 13, 1911, provided the extent of the repairs as defined by law makes this necessary. In such cases, cars to be stenciled as per M. C. B. Circular No. 17, and bill made against owner for the cost.

ARBITRATION COMMITTEE RECOMMENDATION.

Your committee suggests that the rule remain as it it for the reason that there is such a variation in the details of car construction, and such a variation in the standards of different railroads that the suggestion is not practicable.

The Arbitration Committee has done very important service to railroad companies, and has not lost vigor or usefulness under the chairmanship of Mr. J. J. Hennessey.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE.

The constant progress, the fertility of invention and the passion for improvement on railroad machinery make standards almost as transitory as ships that pass in the night. A standard form seems no sooner established than members begin recommending changes. The Committee on the Revision of Standards is loaded with the burden of considering recommended changes and advising the association on the adoption of those that would be likely to turn out to be improvements.

In the last report most of the changes recommended were on journal boxes and details. Few of them called for much change. Here is an ordinary example: "Pages 677 to 678, Sheets M. C. B. 3, 6, 9 and 12. A member calls attention to the absence of any recommended standard way of fastening oil-box covers on freight and passenger equipment, and suggests that in using bolt, and after nut is securely fastened, the end of bolt protruding through the nut be riveted over so as to make it impossible for the nut to work off.

"Your committee does not concur in this recommendation as it is not in accordance with the standards of the association, which calls for a split key."

Most of the other changes recommended relate to safety appliances, arch bars, automatic couplers, lumber specifications, lettering cars, springs and spring caps, etc. The Arbitration Committee agreed to about half the changes called for.

TRAIN BRAKE AND SIGNAL EQUIPMENT.

The committee investigating this subject made recommendations concerning the following questions, and their work seems to have brought air brake and signal equipment up to date.

I. Proper Weights of Freight Cars to Take 10-inch Brake Cylinders.

II. Adoption of K-1 and K-2 Triple Valves as Standard for all Freight Equipment.

III. Proper Size of Brake Pipe to Use on Passenger Car Equipment.

IV. Swinging Clamps for Ends of Brake and Signal Pipes on Passenger Cars.

V. Galvanized Brake Pipe and Fittings for Refrigerator and Coal Cars.

VI. Standard Brake Pipe Socket or Nipple.

VII. Position of Hose Clamp Bolting Lugs on Mounted Hose.

VIII. The M. C. B. Standard Hose Label.

COUPLER AND DRAFT EQUIPMENT.

The committee which wrestled with the above subject made a most formidable report which covered 66 pages, and had in addition 87 pages of illustrations and tables. To those interested in the subject we recommend a careful study of the full report.

Last year the Executive Committee of the M. C. B. Association instructed the committee on coupler and draft equipment to proceed with the work of designing an M. C. B. standard coupler in conjunction with the coupler manufacturers and the report states that has been done.

COUPLER TESTS—STATIC AND DYNAMIC.

The tests outlined in report of last year were conducted by the Pennsylvania Railroad Company under the direct supervision of Mr. C. D. Young, Engineer of Tests and the chairman of your committee. These tests were started April 3, 1912, carried along continuously, using Pennsylvania Railroad testing facilities, as well as those of the Baltimore & Ohio Railroad, the Baldwin Locomotive Works and the Pressed Steel Car Company to expedite the work, and were completed April 24, 1913. A total of 481 tests were made, as follows:

(Pb)	Static pulling tests, complete coupler	47
(Hb)	Static guard-arm test (pulling)	45
(Ab)	Static tensile tests of coupler lugs	45
(Bb)	Tensile tests of material	45
(Yk)	Static pulling tests of separate knuckle	45

(Sb)	Dynamic strike tests, complete coupler	45
(Gb)	Dynamic guard-arm tests, coupler body	45
(Fb)	Dynamic face tests, coupler body	45
(Jb)	Dynamic jerk tests, complete coupler	45
(Sk)	Dynamic knuckle-strike tests, separate knuckle	37
(Jk)	Dynamic knuckle-jerk tests, separate knuckle	37
	Total tests	481

The couplers used in these tests comprised the couplers in general use to-day, as well as some reinforced or strengthened couplers which were in course of development, as follows: Pitt, Major, Latrobe, Major Special 103, Gould "Z," Janney "X," Sharon, Krakau, Alliance, Bazeley and Simplex.

The report supplies full particulars of all the tests.

LOCOMOTIVE EQUIPPED WITH STREET MECHANICAL STOKER AT WORK ON THE BALTIMORE & OHIO RAILROAD.

Watching a Mechanical Stoker at Work.

The writer has been a believer in the ultimate success of mechanical stokers, for his experience as a locomotive fireman convinced him that the inventive ability of the world, which had transferred so many arduous burdens from the muscles of mankind to that of machinery would not fail in transferring the terrible toil of firing heavy locomotives from the man to the machine. To make personal observation of the progress in using mechanical stokers he made a trip to Cumberland, Md., where the mechanical officials of the Baltimore & Ohio Railroad gave him the opportunity of observing the working of the Street mechanical stoker on different locomotives.

The Baltimore & Ohio Railroad have in operation 65 locomotives equipped with Street mechanical stokers, 50 of them being Mikados, 14 Mallets and 1 consolidation. Through the courtesy of Mr. T. R. Stewart, master mechanic, I was given the opportunity of watching the operation of the stoker equipped locomotives that were working about Cumberland, which occupied one day. Next day Mr. F. Kerby, supervisor of locomotive operation, took me in charge and escorted me to the cab of two locomotives, where I had the opportunity of seeing the stokers perform the duties of firing, as I had never seen firing done before. Mr. Kerby went to much trouble to make my visit and purpose agreeable.

The first experience was on engine 4172, which took hold of a train of 37 cars weighing approximately 2,000 tons and hauled it 50 miles in 72 minutes. I have had experience in the cab of engines hauling express passenger trains at speeds touching a mile a minute, but this was the first time I had experience on a heavy freight train making such speed and it was very interesting and exciting.

My attention was directed to the steam gauge and to the way the coal found its way into the firebox. Steam was all the time kept close to the blow-off point and the attention of the fireman was closely devoted to the operation of the stoking mechanism. The impression I received was that the man operating the stoker must possess quite as much intelligence and skill as the man who "keeps her hot" by means of the scoop.

The next experience was on another Mikado engine which took hold of a train of 66 cars weighing about 5,350 tons. That was a tremendously heavy train and it was hauled over an undulating track with grades about four-tenths of one per cent. The engine hauled that train 11 miles in 37 minutes, being over 17 miles an hour. At some points the speed was down below ten miles an hour, the engine doing its best with full steam pressure which the stoker maintained steadily. The fireman was quite busy regulating the action of the stoker but there was no want of steam. It was a phenomenal performance the pulling of that heavy train and the quantity of coal burned would have overtaxed the physical endurance of a particularly strong man had hand firing been employed, and it is peculiarly gratifying to feel and to know that in a few years firing heavy locomotives by hand will be unheard of.

Items of Personal Interest

Mr. Jos. Bedford has been appointed shop foreman of the Intercolonial at Moncton, N. B.

Mr. R. B. Kries has been appointed road foreman of engines on the Western Pacific, at Elko, Nev.

Mr. W. J. Ridley has been appointed road foreman of engines on the Northern Pacific at Fargo, N. D.

Mr. A. S. Teague has been appointed master mechanic of the Denver & Rio Grande at Helper, Utah.

Mr. T. M. Vickers has been appointed general foreman on the Oregon Short Line at Pocatello, Idaho.

Mr. W. H. Davis has been appointed roundhouse foreman on the Texas & New Orleans, at Echo, Texas.

Mr. R. A. Becket has been appointed supervisor of signals on the Grand Trunk with office at Montreal, Can.

Mr. F. J. Wissinger has been appointed general foreman of the Detroit, Toledo & Ironton at Springfield, Ohio.

Mr. Wm. H. Leonard has been appointed storekeeper on the Philadelphia & Reading, at Fort Reading, N. J.

Mr. W. A. Rizor has been appointed foreman of water service on the Chicago, Burlington & Quincy, at Greybull, Wyo.

Mr. Geo. A. Wyman has been appointed assistant master mechanic of the Boston & Maine, with office at Concord, N. H.

Mr. J. McCabe, master mechanic of the New York, New Haven & Hartford, at Waterbury, Conn., has been transferred to Harlem River, N. Y.

Mr. George S. McKee has been appointed superintendent of motive power of the San Antonio and Aransas Pass, with offices at San Antonio, Texas.

Mr. J. E. Stevenson, traveling engineer on the Utah Lines of the Denver & Rio Grande, has been transferred from Midvale, Utah, to Salt Lake City, Utah.

Mr. C. C. Dibble, general stockkeeper of the Cleveland, Cincinnati, Chicago & St. Louis, has been transferred from Cleveland, Ohio, to Beech Grove, Ind.

Mr. E. H. Wade, superintendent of motive power and machinery on the Chicago & Northwestern, has been transferred from Green Bay, Wis., to Perry, Ind.

Mr. R. H. Vaden, formerly general foreman of the Atlantic Coast Line, at Manchester, Va., has been transferred to a similar position on the same road at So. Richmond, Va.

Mr. Chas. S. Hall, formerly master mechanic on the Boston & Maine, at Concord, N. H., has been transferred to a similar position on the same road at East Cambridge, Mass.

Mr. H. G. Kock has been appointed locomotive foreman on the Great Northern at Butte, Mont. Mr. A. L. Miller has been appointed to a similar position on the same road at Billings, Mont., and Mr. F. W. Ramer has been appointed to a similar position on the same road at Glasgow, Mont.

Mr. George W. Wildin has been appointed mechanical superintendent of the Central New England, at New Haven, Conn. This appointment is in addition to the duties already devolving on Mr. Wildin's position as mechanical superintendent of the New York, New Haven & Hartford.

Mr. C. A. Henry, formerly foreman of the erecting shop of the Chicago, Burlington & Quincy, at Aurora, Ill., has been appointed superintendent of shops at West Burlington, Iowa, in place of Mr. J. A. Carney, who has been appointed superintendent of shops at Aurora, in place of Mr. A. Forsyth, deceased.

Mr. T. N. Armstrong has been appointed road foreman of engines on the Chesapeake & Ohio, at Lexington, Ky. Mr. G. F. Fuller has been appointed to a similar position on the same road at Peru, Ind., and Mr. C. S. Louben has also been appointed to a similar position on the same road at Cane Fork, W. Va.

Mr. E. S. Barnum has been appointed general foreman on the Pennsylvania Lines west of Pittsburgh, at Xenia, Ohio. Mr. R. H. Flinn has been appointed to a similar position on the same lines at Louisville, Ky., and Mr. C. W. Kinnear has been appointed to a similar position on the same road at Bradford, Ohio.

The following have been appointed road foremen of engines on the Baltimore & Ohio: Mr. G. N. Gage, at Connellsville, Pa.; Mr. T. S. Deveney, at Chicago Junction, Ohio; Mr. J. M. Gough, at Wheeling, W. Va.; Mr. W. J. Head, at Cleveland, Ohio; Mr. B. H. Miller, at Connellsville, Pa., and Mr. E. C. Pope, at Baltimore, Md.

Mr. J. Bleasdale, formerly supervisor of air brakes on the Baltimore & Ohio, at Wheeling, W. Va., has been transferred to a similar position on the same road at Baltimore, Md., and Mr. J. D. Beltz, formerly road foreman of engines on the same road at New Castle, Pa., has been transferred to a similar position on the same road at Glenwood, Pa.

Mr. J. F. Bowden, formerly master mechanic on the Baltimore & Ohio, at Garrett, Ind., has been transferred to a similar position on the same road, at Newark, Ohio. Mr. A. McCormick, formerly general foreman in the locomotive department on the same road, at New Castle, Pa., has been transferred to a similar position at Connellsville, Pa.

Mr. H. C. Oviatt, for a number of years inspector in the mechanical department of the New York, New Haven & Hartford, has been appointed assistant mechanical superintendent of the same road with offices at New Haven, Conn. Mr. J. L. Crouse has been appointed superintendent of shops on the same road at Van Nest, N. Y. Mr. C. H. Reid has been appointed master mechanic on the same road at Waterbury, Conn., and Mr. W. F. Nelson has been appointed general road foreman of engines on the same road at New Haven, Conn.

Mr. H. C. Hooker, for the last twelve years secretary to President Underwood of the Erie, has been advanced to the position of assistant to the president. Mr. Hooker began railroad work as a stenographer in the office of vice-president and general manager of the Baltimore & Ohio Railroad and proved so useful there that he was brought to the Erie when Mr. Underwood became president of that road. A peculiarity of Mr. Hooker's is his masterly grasp of details. That is a most useful charactertistic, and has helped many a railroad man to the top of the tree. We have no doubt that Mr Hooker will make rapid progress toward one of the most exacted positions in the railroad world.

The following new appointments have been made on the Missouri, Kansas & Texas: Mr. N. L. Smitham, assistant superintendent of motive power at Denison, Tex.; Mr. G. P. Letts, master mechanic at Sedalia, Mo.; Mr. W. J. Shuber, master mechanic at Parsons, Tex.; Mr. J. Malsed, master mechanic at McAlester, Okla., and Mr. E. E. Messmer, master mechanic at Smithville, Tex. Road foremen of engines have also been appointed on the same road as follows: Mr. A. Hallman, at Smithville, Tex.; Mr. J. H. Henley, at McAlester, Okla.; Mr. Bow Hooper, at Waco, Tex.; Mr. H. Hooper at Denison, Tex.; Mr. A. H. McDonald, at Oklahoma City, Okla.; Mr. W. Rothmeyer, at Sedalia, Mo., and Mr. C. E. Stanton, at Smithville, Tex.

Mr. John L. Nicholson, president of the Locomotive Arch Brick Company, is a

railroad man of considerable experience, having served as fireman, engineer and road foreman of engines on the Chicago & North Western. In 1904 the American Locomotive Equipment Company purchased an invention largely perfected by Mr. Nicholson, and known as the "Wade-Nicholson Hollow Arch." When the American Arch Company was formed, which company took over the entire business of the American Locomotive Equipment Company, Mr. Nicholson was appointed Southern sales manager, and in May of the present year he was elected director, vice-president and general sales manager, with headquarters at 1201 Chamber of Commerce Building, Chicago. Mr. Nicholson subsequently was elected president, and under his supervision the success of the Locomotive Arch company is assured. The company is backed by the Thomas Molding Company, which was established in 1861. At present the company is placing on the market a sectional arch, known as the "Economy

JOHN L. NICHOLSON.

Arch," which is being manufactured under the Stevens patents, and which is meeting with much popular favor.

William T. Noonan.

In addressing the Apprentice Schools belonging to the Erie Railroad, it has become the practice of Dr. Angus Sinclair, the special instructor, to outline the experience of railway officials who have risen to prominence through their own exertions. Among the officials recently used as examples of what hard work and perseverance may accomplish, was that of William T. Noonen, president of the Buffalo, Rochester & Pittsburgh Railway.

Dr. Sinclair said: Among the younger class of men who have made rapid progress in rising upwards on the ladder of railway life I entertain a very high regard for William T. Noonen, president of the Buffalo, Rochester & Pittsburgh Railway. When I first made the acquaintance of Mr. Noonen he was secretary to the president of the Minneapolis & St. Louis Railway, a position he rose to through hard work and efficiency in lower grades of railway work. I saw enough of Mr. Noonen during a few days visit to feel assured that he was always on his job and that he had acquired wonderful knowledge of the details of a railroad general managers office.

Mr. Noonen is still under forty years of age, and may be called a product of the Northwest where so many bright railway men have come from. He possesses a personal attribute that never fails to send its possessor to the top of his profession or calling. That is he makes his business his pleasure. With him there was no watching the clock for quitting time. So long as there was important work to be done the quitting time had not arrived. He was also an earnest student of subject that would increase his general knowledge, through which he acquired information that increased his value as a railway official and aided his upward progress. When yet almost a boy he had obtained full appreciation of the value of knowledge. That is a treasure easily carried about and the possessor never knows when it may be utilized to good purpose.

After obtaining the broad, solid foundation of railway operating that Northwest practice confers Mr. Noonen was appointed assistant general manager of the Erie Railroad, the very best school on the Eastern seaboard for teaching a man details of railroad operations under difficulties. Many of our friends are ready to testify that on the Erie Mr. Noonen made good and proved himself exceedingly efficient in handling his part of the train service. He displayed great vigor in wrestling with train blockades and never failed to be on hand when hard work was to be done. Those who speak about his work on the Erie say that he was always patient and smiling, offering a suggestion here, giving an order there and always ready to consult with yardmasters, conductors and others knowing how to help. This was his mature apprenticeship to practical railway operating and it prepared him for a higher position on the Buffalo, Rochester & Pittsburgh Railway.

His subsequent career can be briefly told. General superintendent of the Buffalo, Rochester & Pittsburgh in 1904; less than two years afterwards general manager and in 1910, when thirty-six years old, elected president. None of that rapid progress was due to accident. It was all earned by hard work and is the finest kind of an example for you young men who are working near the foot of the ladder with much better prospects than Mr. Noonen had when he entered railroad life.

Obituary

ALEXANDER FORSYTH.

Alexander Forsyth, the well known master mechanic of the Chicago, Burlington & Quincy Railroad, at Aurora, Ill., passed away in May last from the effect of a surgical operation. Mr. Forsyth was an Englishman by birth and came to the United States in 1867. After working for two years at his trade of machinist in Eastern shops he went to Aurora and began work for the C. B. & Q. company, with which he remained for the rest of his life. His rise was very much like the experience of other master mechanics to be found on every railroad in the United States—machinist, gang foreman, general foreman, master mechanic, shop superintendent.

Many of the most eminent mechanical men on American railroads received valuable training under Mr. Forsyth, while others were associated with him in warm

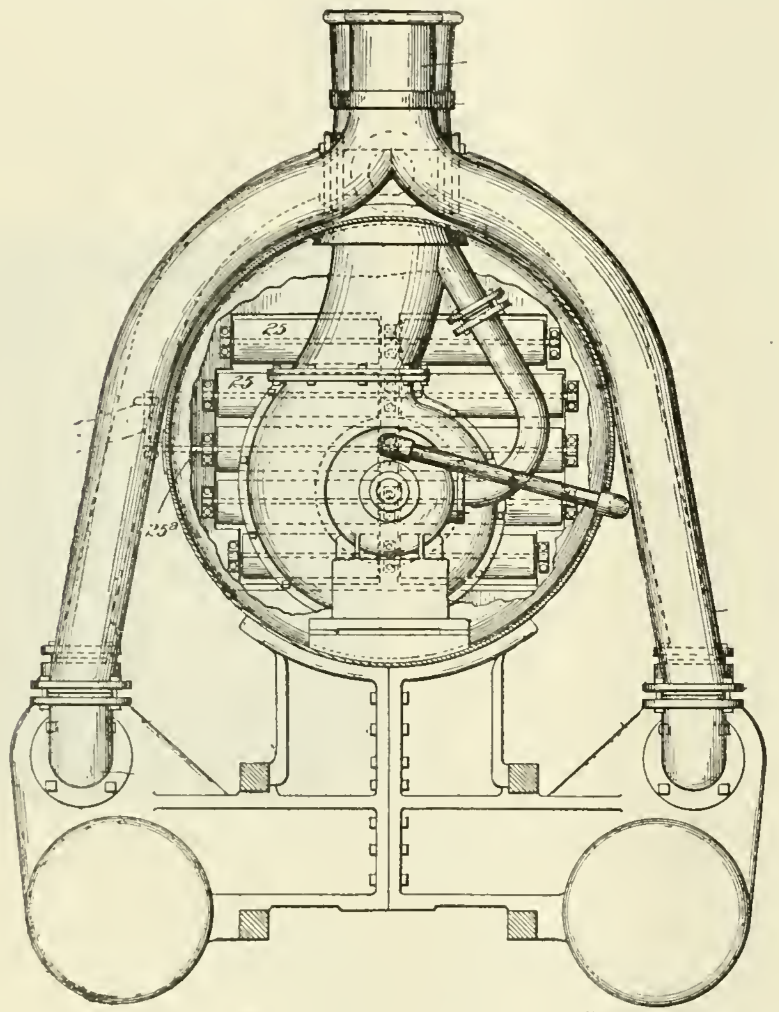
ALEXANDER FORSYTH.

personal intercourse. Among these was Mr. Henry B. Stone, who afterwards became president of the company. Mr. J. F. Deems, now at the head of the Standard Heating & Ventilating Company, was an intimate friend. Mr. Frederick Delano, now president of the Wabash Railroad, worked under Mr. Forsyth, as did Mr. E. M. Herr, president of the Westinghouse Electric Company. Mr. L. E. Johnson, now president of the Norfolk & Western Railroad, was a division superintendent at Aurora, and others in high places in different parts of the railway world derived lasting benefit from association and friendly intercourse with Mr. Forsyth. Mr. W. C. Brown, now president of the New York Central Lines, was division superintendent, associated with Mr. Forsyth as master mechanic and Mr. Brown talks very kindly about the association he then enjoyed.

New Draft Appliance on Locomotives

A new method of applying draft in firing a locomotive has been invented and patented by Mr. Helon R. MacFarland, of Topeka, Kan., and as shown in the accompanying illustration consists in leading the exhaust steam from the valve chambers into the atmosphere without conducting it through the smoke-box of the boiler, as has heretofore been necessary for the purpose of producing the requisite draft for the gases of combustion, thereby eliminating any hindrance or back pressure on account of the tortuous winding or narrow exhaust passages now in use, also admitting of greater stability in the cylinder and valve chamber castings.

The port or smoke-box end of the locomotive is divided into separate compartments by a partition which is intended to be air-tight. A blower or fan communicates with the smokestack by means of a delivery tube whereby the gases of combustion are ejected from the locomotive. The delivery tube is so secured in the base or flue of the smokestack as to provide an intervening space which permits of circulation about the delivery end of the tube. The front end or head of the locomotive may be provided with a suitable number of air inlets or ventilating openings, thus permitting circulation of fresh air, which is taken in through the openings and ejected through the stack, induced by the ejector action of the blower or fan through its delivery tube. The driving means, preferably consisting of a steam turbine, may be of a well known construction and is driven by steam conducted thereto from the boiler of the locomotive. The live steam pipe is provided with a suitable valve in the cab of the locomotive, so that operation of the draft inducing means may be controlled from the cab. The exhaust pipe may be provided with a muffler whereby the noise of the exhaust may be reduced.



NEW DRAFT APPLIANCE ON LOCOMOTIVES.

An adjustable baffle plate is also provided, and shutters are arranged and pivotally connected to a connecting link and rocker arm with means extending to the cab of the locomotive, whereby the baffle member may be operated as desired by the engine man. By this means the draft of the locomotive may be regulated and equalized so that an even fire in the grates may at all times be maintained.

A manhole is also provided on the side of the shell and preferably on the rear compartment of the smoke-box, so that proper inspection may be made at any time. The invention may be modified in certain details without, however, departing from the principle of the invention.

Brakeman Gets New Nose.

An accident to a railroad brakeman made the opportunity for the performance of an extraordinary surgical operation. According to the New York *Times,* Adam Williams last winter had his nose broken when he struck an overhead bridge. He was taken to a hospital in Baltimore and is now convalescing with a new nose built of bone taken from one of his ribs. After he was hurt the surgeons removed the broken bones from his nose, but he had to breathe through silver tubes until the wound had healed. This, however, left him minus two nasal bones, and the bridge of his nose was flat on his face.

Recently the surgeons decided upon a second operation. They made an incision in his right side, sawed a thin piece of bone from his third rib, and cut it into two pieces the shape of two nasal bones. These were fitted against the cheek bone and the nose fashioned into its proper shape. The nose then was placed in a plaster cast, and the doctors say it is as good as ever.

The incident reminds us of an incident of our early railway experience. The writer was on top of a tender taking water when his curiosity was roused by the curious appearance of a trackman's nose. We kept staring when the man looked up coolly and remarked, "It's leather." He understood what excited our attention. He wore an artificial proboscis made of leather.

Position of Ship Lamps.

In a very amusing story called the "Vital Spark," by Hugh Foulis, the doings on a steam barge trading on the Clyde are related. In one place the author gives great offense to the skipper by saying that he ought to carry a light on the stern to prevent other craft from running him down.

A similar condition is mentioned of a steamer trading on the Mississippi when steamers were more numerous there than they are today. One night the *Mountain* set out from New Orleans and before morning about twenty other steamers had passed her. She usually carried one signal light in front. About the time all the fleet had passed the skipper missed the signal light and shouted to the watchman and profanely demanded why the light was absent. "I know what I'm about," replied the shrewd watchman, "the light is hanging over the stern." The danger was from the rear.

RAILROAD NOTES.

The Chesapeake & Ohio is in the market for 1,000 freight cars.

The Great Northern Ry. is reported in the market for 18,000 tons of rails.

The Missouri, Kansas & Texas is stated to be in the market for 12,000 tons of rails.

The North Coast has ordered 2,500 tons of bridge material from the American Bridge Co.

The Southern is reported in the market for 15 Mikado locomotives and 10 Pacific type locomotives.

The Cordoba Central, Argentina, has ordered 10,000 tons of rails from the United States Steel Corporation.

The Norfolk & Western has ordered 3,000 tons of bridge material from the United States Steel Corporation.

The Alabama, Tennessee & Northern has been awarded a contract for the building of new shops at York, Ala.

The Peoria & Pekin Union has ordered 25 hopper coal cars from the Central Locomotive & Car Works, Chicago, Ill.

The Louisiana Ry. & Navigation Co. has ordered three ten-wheel locomotives from the Baldwin Locomotive Works

The Pacific Ry., of Colombia, it is reported, has given the United States Steel Corporation a trial order for 1,200 steel ties.

The International & Great Northern has an order with the American Car & Foundry Co. for 800 thirty-ton and 200 forty-ton coal cars.

The United States Government has ordered 1 four-coupled locomotive from the Baldwin Locomotive Works for the Sandy Hook proving ground.

George H. Hardner, of Allentown, Pa., has been awarded the contract to erect a 20-stall roundhouse and locomotive repair shop by the Bethlehem Steel Co.

The Brinson Ry., it is stated, will remove its shops from Springfield to Savannah, Ga. Shop capacity will be largely increased and new machinery added.

The Seaboard Air Line, it is said, has ordered 1,000 steel underframe box cars from the Pressed Steel Car Co., 250 steel hopper cars from the Standard Steel Car Co., and 250 steel underframe flat cars from the American Car & Foundry Co.

The Chicago & Alton has appropriated $987,000 for the erection of new shops at Bloomington, Ill. A roundhouse and additional yards have already been built, a passenger station is now under construction, and additional yard tracks are contemplated.

The Imperial Taiwan Railway, of Formosa, has ordered one superheater Pacific passenger locomotive with 18½ x 24 in. cylinders, driving wheels 63 in. in diameter and a total weight of 137,000 lbs. in working order from the American Locomotive Co.

The Amaga R. R. of Colombia has ordered 2 prairie type locomotives from the American Locomotive Co. The dimensions of the cylinders will be 12 x 16 in., the diameter of the driving wheels will be 33 in., and the total weight in working order will be 62,000 lbs.

The Chicago, Rock Island & Pacific has ordered 2 mountain type passenger locomotives from the American Locomotive Co. These locomotives will be equipped with superheaters, will have 28 x 28 in. cylinders, 69 in. driving wheels, and in working order will weigh 328,000 lbs.

The Baltimore & Ohio has ordered 500 gondola cars from the Cambria Steel Co.; 40 baggage cars from the American Car & Foundry Co.; 5 seventy-foot combination baggage mail cars, 7 fifty-foot combination passenger baggage cars, 25 seventy-foot coaches, 15 sixty-foot smoking cars, and 4 seventy-three-foot dining cars from the Pullman Company.

The Bessemer & Lake Erie has ordered 4 superheater Pacific passenger locomotives with 24 x 28 in. cylinders, driving wheels 73 in. in diameter and a total weight of 232,000 lbs. in working order, and 8 consolidation freight locomotives with 22 x 30 in. cylinders, driving wheels 54 in. in diameter and a total weight of 205,000 lbs. in working order from the American Locomotive Co.

The New York Central Lines have ordered 114 locomotives from the American Locomotive Co. These are for the following lines: New York Central & Hudson River, 21 Pacific type locomotives; Michigan Central, 25 mikado and 8 Pacifics; Lake Shore & Michigan Southern, 3 Mallet, 5 Pacific and 20 8-wheel locomotives; Toledo & Ohio Central, three 8-wheel locomotives, and the Cleveland, Cincinnati, Chicago & St. Louis, 10 mikado locomotives.

Joint Agreement Between Locomotive Engineers and Firemen.

At the annual convention of the Brotherhood of Locomotive, Firemen and Enginemen held at Washington last month, publicity was given to what is known as the "Chicago Joint Agreement between the Brotherhood of Locomotive Engineers and Brotherhood of Locomotive Firemen and Enginemen." By this agreement the organizations of engineers and of firemen will be brought into closer relationship than they have hitherto been. The following are the most important items of the agreement which we are persuaded is destined to promote good will and harmony among the men constituting these influential brotherhoods:

We affirm the right to make and interpret contracts, rules, rates and working agreements for locomotive engineers shall be vested in the regularly contstituted committee of the Brotherhood of Locomotive Engineers, and, conversely, the right to make and interpret contracts, rules, rates and working agreements for locomotive firemen and hostlers, shall be vested in the Brotherhood of Locomotive Firemen and Enginemen: Provided, That on roads where but one organization has representation or maintains a committee, such organization shall have the right to negotiate schedules for all men in engine service.

Where joint agreements are made in the future the two committees shall endeavor to obtain yard engineers' rate of pay for hostlers required to make main line movements, and when such rate is obtained these positions shall be filled by engineers as fast as vacancies occur.

In case of a dispute between the two organizations which the joint committees or officers placed in charge thereof, fail to adjust, the matter shall be referred to the two Chief Executives, with a statement of the facts upon which each side bases its contentions. The two Executives shall consider and decide the matter in controversy, and their decision shall be final. In case the Chief Executives fail to agree the matter shall be submitted to arbitration and the decision of the arbitrators shall be final. When a decision has been reached, as above provided, both organizations shall unite in enforcing such decision.

Engineers or firemen in actual service, members of both organizations, shall be required to pay all dues and assessments required of members of each organization.

The right of any engineer, fireman or hostler to have the regularly constituted committee of his organization represent him in the handling of his grievances, in accordance with the laws of his organization and under the recognized interpretation of the General Committee making the schedule involved, is conceded.

In case either organization shall make an issne and declare a strike independent of the other organization, whether there is a joint working agreement or not between the committees, the organization making the issue will not order a strike of its members who are working under an agreement made by the other organization, and it shall be understood that should the Brotherhood of Locomotive Engineers order a strike, it will not require its members who are firing, to quit their positions as firemen, and if the Brotherhood of Locomotive Firemen and Enginemen shall order a strike, it will not require its members, who are running engines, to quit their positions as engineers.

When a strike is called by one organization the members of the other organization shall not perform any service that was being performed, before the strike was called, by the members of the organization who are on strike.

When a member of either organization has a grievance which the local committee of his organization is unable to adjust with the local officers of the company, the matter shall be referred to the General Chairman, who shall unite and work jointly in handling such grievance to its final conclusion.

In case of any dispute, between the two organizations that is finally decided in favor of either organization, as against the contentions of the other, or in case any General Chairman or General Committee fails or refuses to act jointly with the General Chairman or General Committee of the other organization, the organization in whose favor the decision is made shall not be limited in its power to enforce the decision made in its favor by the limitations as published.

The principle of joint schedules for engineers, firemen and hostlers is affirmed, and it is the recommendation of this Committee that joint meetings of the General Committees on every system of railroad be arranged for in future schedule negotiations. The policy of joint action herein subscribed to shall also apply to concerted wage movements.

During the conference Grand Chief Stone assured the Joint Conference that the Harrisburg Convention of the Brotherhood of Locomotive Engineers had taken such action as would vest in the Committee representing the Brotherhood of Locomotive Engineers complete authority to place in effect any amendments or changes in the laws of the Brotherhood of Locomotive

Engineers necessary to complete the foregoing Working Agreement. Grand Chief Stone assured the Joint Conference that so far as the Brotherhood of Locomotive Engineers were concerned, all laws of the Brotherhood of Locomotive Engineers that were conflicting with this Working Agreement were being changed after ratification by the Convention of the Brotherhood of Locomotive Firemen and Enginemen, which was held in Washington, D. C., in June 1913.

President Carter advised the Joint Conference that the resolution of the St. Paul Convention of the Brotherhood of Locomotive Firemen and Enginemen authorized the Committee representing that organization to negotiate a Working Agreement, but if such Working Agreement would require a change in any of the laws or schedules of wages and working conditions of the Brotherhood of Locomotive Firemen and Enginemen, the Working Agreements were nearly all ratified by the Twenty-sixth Convention of the Brotherhood of Locomotive Firemen and Enginemen assembled in Washington, D. C., in June, 1913, and it was with this understanding that the foregoing Working Agreement was signed by all parties thereto.

Train Dispatching with Product of a Factory.

Imitation is said to be the greatest flattery. The railway train dispatchers must be gratified at imitation of their methods by a great manufacturing company as described by the *Michigan Manufacturer* as follows:

Fifteen thousand cars were handled in the yards of the Buick Motor Company, of Pontiac, during the year, inclusive of the thirteen trainloads of Buicks sent to the west. Outgoing cars numbered 7,600, and incoming freight 8,000 carloads.

The company has comparatively recently installed a new system whereby a dispatcher is put in charge of all inter-factory deliveries by means of motors running in the streets. He sits all day with a telephone receiver clamped to his ear, directing the drivers from one loading station to the next. There are 22 motor trucks and ten horse-drawn vehicles always on the job, and it is estimated that the system saves the company in the neighborhood of $100,000 a year.

Four switch engines are kept all day, and two all night, shunting cars and making up trains in the Buick yards. Three transfer cars are kept busy at the motor building for loading during the day, and at night they are rolled up to the dock at the assembly plant.

It is remarkable that this economical method of dispatching was not then thought of, and put in operation before this time.

Practical Piety.

A Sunday School teacher was trying to impress upon the young hopefuls in her class the necessity for asking a blessing before eating. It was in Indiana where the practice of saying Grace before meat is not widely practiced. "Billy," she asked a bright urchin, "What prayer does your father say before you eat your dinner?" "I dun know." "Well, what did he say this morning before breakfast?" Billy meditated; suddenly he remembered and beamed. "He said, 'You kids go slow on the butter now. It's forty cents a pound.'"

Some Welsh Words.

Welsh is a marvelously expressive language. In a souvenir guide to Carnarvon there is a list of Welsh railway stations with their English equivalents. Here are some of them: "Abergwynfi, entrance to the place of bliss; Amlwch, a place of frequent expansion; Cefn Brynich, the back of the screaking hill; Dowlais, the voice of God, and Llanbister, the manure yard road." There is also one station the name of which runs to fifty-eight letters. Its meaning is merely: "The fair church at the pool of the white seagull near the alder grove where the fodder for the oxen is stored in the red barn." And surely teetotalism ought to flourish in a country where beer is known as "cwrw."—*The Employes Magazine.*

Not Twins.

Two new scholars came to a school the other day. "Are you brothers?" asked the teacher. "Yes," answered one of the boys, and as their ages were both the same the teacher remarked, "Then you must be twins?" "No," said the boy. The teacher, after a minute's thought, said, "Well, if you are brothers, and both the same age, I'll admit you are more clever than I am if you can prove that you are not twins." "No," said the boy, "we're not twins. We're triplets, but the other one died."

Too Close a Fit.—Mr. McGuire (to hospital attendant)—"Phwat did ye say the docther's name was?"

"Dr. Kilpatrick."

"Thot settles it. No docther wid thot cognomen will git a chance to operate on me—not if I know it!"

"Why not?"

"Well, yez see, my name's Patrick."

Nautical Notes.—Mrs. Yacht—superciliously—My husband has a beautiful yacht. I don't suppose your husband can afford such a luxury, yet?

Mrs. Nacht.—No, the best he can do is to hold the mortgage on the one your husband has.

The Commerce Court.

We have repeatedly commented upon the action of the Commerce Court in standing out against unfair action of the Interstate Commerce Commission. Its fairness has brought enmity to the Commerce Court and an underhand attempt is made to put an end to its usefulness. A recent issue of the New York *Times* says:

The Merchants' Association has passed a formal protest against the abolition of the Commerce Court, whose activities will cease with the financial year unless provision is made for its expenses. This is another case of sneak legislation. A court once created lives until its existence is lawfully ended. The Commerce Court is not disestablished, but the payment of its bills is stopped, and this is done by a "rider."

The appeal is made in the interest of the shippers, who have no other means of relief from a negative or adverse decision of the Interstate Commerce Commission. The interest of the railways is the same as of the shippers, for no party to a litigation benefits or has a right to benefit by impediments to decisions of disputes on the merits. Doubts and delays rival injustice in embarrassing business. The Commerce Court has done what was expected of it in simplifying and hastening procedure. Its abolition would benefit no deserving interest. And the manner of its abolition is an insult to all courts, any of which may stand next in line for similar starvation.

Calling the Engineer Engine Driver.

In commenting upon the disastrous collision that happened on the New York, New Haven & Hartford railroad last month, nearly all the New York papers termed the man who ran the engine the "engine driver." That is the term used in Great Britain for the locomotive engineer, but it does not belong to American railroad nomenclature. No railroad company in the United States has on its roll of employees a person called an "engine driver." To us it seems that the practice of calling the locomotive engineer an engine driver is a piece of silly imitation of English as it is spoken in the British Isles.

Iron and Steel Industries In Germany.

We have received from an occasional correspondent, Paul Wener, consulting engineer, Dusseldorf, Germany, a circular intimating that Mr. Wener carries on a consulting engineer's office which furnishes reports on all matters relating to the iron and steel industry, mining, waterworks, electrical installations, etc.

All communications in regard to these industries directed to Mr. Wener will receive prompt and courteous attention.

Hay-Budden Anvils.

The Hay-Budden Manufacturing Company, 254 No. Henry street, Brooklyn, N. Y., who had the enterprise to begin the manufacture of anvils in America, and competed successfully with the low paid labor of Europe, continue to add to the popularity of their products and have not only driven out the foreign manufacturers but continue to enjoy a long lead ahead of the imitators that have arisen in America to contest with them in their specialties. The marked success of this enterprising firm did not come to them over night. Their success has been largely owing to their own inventive genius, coupled with a generous treatment to their skilled workmen. Recent marked improvements in their extensive plant enable them to produce anvils of a solid forged steel top which, welded to a solid forged base, makes the anvil entirely solid, and completely avoids the possibility of loose faces or other familiar defects peculiar to the primitive methods of anvil manufacture. In addition to their commanding American trade the company is now successfully competing with foreign manufacturers in foreign countries. It may be added that wherever the Hay-Budden anvils are introduced, their superiority is immediately apparent. In addition to being the first in America they are the best.

United States Service Positions for Railway Men.

We have received from Mr. John McIlhenny, acting president of the United States Civil Service Commission at Washington, D. C., a list of papers giving particulars of examinations for men seeking to enter the government service. Those wishing to compete for the places should apply to the United States Civil Service Commission, Washington, D. C., for Form 2039. The examinations will be held on or before July 21, 1913.

Applications for forms should be sent in at least one week before examination.

Examination.	Salary.
Senior structural draftsman	$1,800 to $4,000
Senior mechanical engineer	1,800 to 4,800
Senior railway signal engineer	1,800 to 4,800
Senior electrical engineer	1,800 to 4,800
Senior inspector of car equipment	1,800 to 3,600
Senior civil engineer	1,800 to 4,800
Senior inspector of motive power	1,800 to 3,600
Senior architect	1,800 to 4,800
Architect	1,080 to 1,500
Inspector of motive power	1,200 to 1,500
Civil engineer	720 to 1,500
Inspector of car equipment	1,200 to 1,500
Electrical engineer	1,080 to 1,500
Railway signal engineer	1,080 to 1,500
Mechanical engineer	1,080 to 1,500
Structural engineer	1,080 to 1,500

Necessary expenses when absent from headquarters in the discharge of official duties will be allowed.

Positions for which the salaries are $1,800 or more do not require the applicants to assemble at any place for examination.

Railway and Locomotive Engineering

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On the Mobile & Ohio Railroad

The left or eastern bank of the Mississippi river has, during the present century, become the most highly favored portion of America in the matter of railway communication. Several causes have led to this, among which are the amazing richness of the soil, which together with the almost unbroken, or, at most, slightly undulating surface of the land, render it peculiarly adaptable to railroad construction. While the wealth of the soil was generally known for many years, it was only recently that the introduction of a large number of plants and shrubs and trees hitherto unknown in the region were introduced, and the success has been phenomenal. Scientific investigation and experiment have demonstrated the fact that two or three crops may be gathered from the same ground in one season, and, all of them equal to the best in less favored regions where one crop is gratefully received.

The Mobile and Ohio railroad passes through this highly favored region, and the enterprising management has been quick to prepare every available means to inform the general public of the agricultural and other advantages that are placed within easy reach. The result is that large tracts of land formerly of little or no value are now being rapidly transformed into the richest fruit growing regions of America. The buildings that are springing up everywhere, especially the luxuriant homes of the settlers, are in sharp contrast to those of the Northern and Western farmer. The luxuriant wealth of foliage bearing trees peculiar to the South and Southwest is utilized in the vicinity of the residences of the settlers and present a most picturesque and inviting aspect.

THE MOBILE & OHIO RAILROAD CROSSING THE ALTO PASS HILL, ILLINOIS.

The Mobile & Ohio railroad has set the pace in elegant and commodious architectural construction. The terminal at Mobile, while not as large as some of the more recent terminal structures in

the North, is in point of elegance equal to the best. The same may be said of the terminal at St. Louis, Mo., and it may be stated that on leaving St. Louis the line parallels the Mississippi river to the northern boundry of Tennessee from which point it bears away to the southwest and enters Mississippi well toward its northeast corner, after running through the general farming and fruit districts of Southern Illinois. Western Kentucky and Western Tennessee, with their fertile clay-loam soils and river bottomlands and penetrating good wheat, corn and grass lands, important trucking sections and good stockraising districts.

After reaching Mississippi the Mobile & Ohio for nearly thirty miles runs along the border line of what is known as the Northeast Highlands and Northeast Prairie sections and then fairly bisects the well-known Mississippi Black Soil Belt, so called by reason of the deep black loam soil, for more than a hundred miles before reaching the Flatwoods Belt, a section in which the soil is for the most part a heavy stiff clay, containing a considerable percentage of lime and which is about twelve miles in width. For more than forty miles the Shortleaf Pine Region is then traversed, following which is the central Prairie Belt—some twenty miles across—before the Long Leaf Pine Belt is entered upon, shortly before the Alabama State line is crossed sixty miles above Mobile.

The Montgomery division of the Mobile & Ohio strikes northeast from Artesia to Columbus, Mississippi, through the prairie belt and then diverges to the southeast, touching the great iron and coal belt of Alabama and reaching Montgomery, the capital of the State, and the center of a prosperous agricultural community. Several other shorter branches of the road reach into rich sections along the line, affording transportation to the farmers, truckers, fruit growers and manufacturing plants.

That section of the State of Illinois traversed by the Mobile & Ohio is a prosperous and well developed farming region. It is chiefly a grain and stock country, with considerable dairy interests, and a very well-known apple district. In the fruit district, a spur of the Ozark gives an elevation sufficient to render a good apple climate, and there are tracts of excellent fruit soils. These soils are the prevailing dark loam type, rich in potash and iron, and large yields of apples are produced. Considerable orchard development extends as far south as Jonesboro and a large quantity of fruit is shipped annually.

As an illustration of the scenery through which the road passes in Illinois the accompanying illustration furnishes a typical scene which has been selected as it is the highest elevation in Illinois where there are many heavy grades and deep cuts over what is known as Alto Pass Hill, and is the only part of the road necessitating double heading passenger as well as freight trains.

Railway Master Mechanics' Committee.

The executive committee of the Railway Master Mechanics' Association met in Chicago July 8 and arranged the business for the coming year, selecting the committees to do the work of investigation. There were present D. R. McBain, F. F. Gaines, E. W. Pratt, Wm. Schlafge, Angus Sinclair, D. F. Crawford, C. F. Giles and W. J. Tollerton.

A new feature of the Executive Committee work this year has been the formulating of elaborate instructions regarding the preparation of reports of committees. We do not have space for all the instructions at present, but we submit that relating to drawings because it applies to every writer who sends illustrated articles to our pages. It reads:

DRAWINGS.

All drawings should be in black ink, on white paper or cloth. Black dimension lines are preferable to red.

Condense all drawings as much as possible, that is, do not have your figures scattered over any larger area than absolutely necessary. After this is done, get the index or keys (such as Sheet I or Sheet K) up close to the drawing to come inside a rectangle bounding the whole. A border line is not necessary.

Always remember that your drawings are reduced in the engraving and therefore must be kept clean and open, with all figures (letters and numerals) clean, clear and large. To illustrate, if you make a drawing 20 inches high, it must be reduced to 7 inches at least. Suppose you make the numerals in your fractions 3/32 inch high, which is fairly large in the drawing, it follows in the engraving that they will be practically 1/30 inch high in the cut, which is far too small to be readable. Either make your numerals large or reduce the scale of the drawing, keeping numerals same size. Do as little shading as possible; you will see the need of this on account of the condensing effect of the reduction.

Do not send in blue prints; send the original tracing if possible. The reason for this is that blue has practically no active value, and the prints must be put through a costly recoloring process, or, in the majority of cases, retraced. Your tracings are not injured by the engraver, but if for any reason they can not be furnished, use black printing-paper, making first a black-print (really a negative), then from this a positive, or a print with black lines on white paper. Any concern selling draftsmen's supplies can furnish this paper with directions for use.

In charts, graphics, etc., on cross-section paper, use a black printed paper if possible to get it; failing this, it is better to draw the whole for the sake of clearness and accuracy.

Do not have any pencil marks in your drawings or tracings; they practically ruin it for the purpose of making an engraving. If you must shade, do it with India ink and keep it open or make it solid as the case requires.

Waterproof ink is always preferable, as the drawing gets considerable handling.

Jos. W. Taylor,
Secretary.

Smoke Nuisance from Roundhouses.

There is little excuse for dense smoke arising out of the operation of stationary plants, as this can be overcome by the use of mechanical stokers using a fuel adaptable to the class of work required. In the case of roundhouses, however, some allowance must be made, as the dense smoke is formed by the lighting of fires and by the banked fires of standing engines. The nuisance resulting is considerable for two reasons.

1. Roundhouses are generally situated within the city limits and near residential districts.

2. The ordinary arrangement is to discharge the smoke from the roundhouse by short stacks. In this way the smoke is more liable to be a nuisance than when discharged from a tall chimney.

The following method of smoke elimination has been used successfully at a 30-stall engine house situated in a residential district of Chicago. The smoke from the stacks is drawn into a main flue by means of exhausters and discharged into a series of washeries, the number depending upon the amount of smoke to be treated. Live steam is also added between the flue and the washery. In washing, the smoke is passed through water under a head of about one inch; this being done in two similar compartments in series. It is estimated that the process will remove practically all the consumed carbon and 75 per cent. of the acids and gases.

Electric Train Stop.

Mr. A. J. Kloneck, New York, has invented a device that is claimed to be a marked improvement in electric train stops, and provides means for the automatic application of semaphores and train stops as well as for distant signals for a single or double track, and also provides means for locking the device in the brake position until the train has been brought to a stop in a predetermined number of miles per hour. An early trial of the device may be looked for.

On the Greater Galveston Causeway

The accompanying illustration shows a partial view of the Greater Galveston Causeway, the construction of which was begun in September, 1909, and has now been in complete and successful operation for nearly two years. A locomotive and train of the International & Great Northern Railway Company is shown crossing the causeway. The structure cost over one and a half million dollars. The height of the roadway is 16 ft. above the average low tide. The total length of the structure is 10,642 ft., or a little over two miles. The great work is divided into four sections, in which there are 2,000 ft. of unprotected roadway; 6,183½ ft. of protected roadway; arch bridge, 2,358½ ft., and lift bridge, 100 ft.

The protected roadway portion has a total width of 119 ft., carrying 40 ft. of county road; 29 ft. for a double track for interurban car traffic; 50 ft. for double track steam railway and room for a third track. There is also 20 ft. 6 ins. of a concrete slope on one side, and 14 ft. 6 ins. concrete slope on the other side. The arch bridge portion has a width of 66 ft., carrying 22 ft. for county roadway; 15 ft. for single track interurban, and 29 ft for double steam railway track. The bridge portion consists of 28 arches, with spans extending to 70 ft., with 11 ft. 9 ins. rise. The foundations for the arches vary from 11 ft. to 16 ft. below the bottom of the bay. A rolling lift bridge is provided, having a width of 52 ft. 6 ins., carrying 23 ft. for county road and interurban track, and 29 ft. 6 ins. for double steam railway track. The causeway has two lines of hand railing 3 ft. high, on both sides of the county roadway.

The structure extends about three quarters of a mile beyond the right of the point shown in the illustration. The lift bridge is in the center of the causeway, and works with a degree of smoothness and exactness that leaves nothing further to be desired. It will be remembered that in the Galveston flood the approaches across the bay to the city were almost totally destroyed. It is to be hoped that the rejuvenated city will never see such another calamity, but as far as the new causeway is concerned, it has been built with a view to meet any war of the elements that may arise.

Apart from the purely local traffic, which is conducted largely by electric cars as shown in the illustration, the causeway is the entrance proper of the International & Great Northern railway. Recent additions to this railway have greatly increased the traffic. The road now extends to over 1,100 miles, with 180 locomotives and 1,250 cars. It connects with the Mexican National at Laredo, Tex., and extends in a nearly straight northeastern line through a rich country to Longview, Tex., where it connects with the Texas & Pacific. On the Gulf of Mexico there is besides the main line running from Galveston, a connection starting from a point further down the coast at Velasco, and joining the main line at Houston. The line from Laredo and the line from Galveston crosses each other at Valley Junction, Tex., a large and growing railway center.

The region traversed by the growing railway is said to be the land of everlasting sunshine, but the rainfall is sufficient to make it, more properly speaking, the land of eternal spring. The district is coming into great favor as a winter resort for northern tourists, and coincidently the railroad is rising to the occasion and the equipment is excellent. It is the quickest and most direct route for traffic between St. Louis and all points north and east, and to Texas and Mexico, and is rapidly coming into marked prominence as an important link in the network of railways that has opened up the wealth of the rich Southwest. The last season was the most prosperous in the history of the enterprising railway.

GREATER GALVESTON CAUSEWAY, INTERNATIONAL & GREAT NORTHERN RAILWAY.

Muscular and Horse Power.

Glibly as every one now talks of horsepower there are few things concerning which the average man knows so very little as he does of what strength the human or the animal is capable of exerting. Some idea of this has come to light through a series of interesting tests recently made to determine the respective pulling power of horses, men and elephants. Two horses weighing 1,600 pounds each, together pulled 3,750 pounds or 550 pounds more than their combined weight. One elephant weighing 12,000 pounds pulled 8,750 pounds or 3,250 less than its weight. Fifty men, aggregating 7,500 pounds in weight, pulled 8,750 pounds, or just as much as the single elephant; but, like the horses, they pulled more than their own weight. One hundred men pulled 12,000 pounds. It may be added that when insects are tested in regard to their capacity for pulling, ants are said to be able to pull many times their own weight.

Canadian Northern.

The Canadian Northern has asked for tenders for a new brick and stone station to be erected at South Edmonton, Alta., to cost $40,000. This road has also plans for the immediate construction of a 15-stall roundhouse and repair shops at Rideau Junction, Ont., where the Transcontinental, Toronto and Montreal lines of the railway converge.

Canadian Pacific.

The Canadian Pacific, it is reported, has let a contract to Foley Bros., Welch & Stewart, Winnipeg, Man., for constructing the 5-mile double track tunnel in the Selkirk mountains, on the Mountain subdivision. Work on the tunnel will be started at once, and it is estimated that it will take about three and a half years to complete this improvement. The work will continue all the year, as excellent accommodations are made for workmen.

General Correspondence

Walschaerts Valve Gear.

Editor:

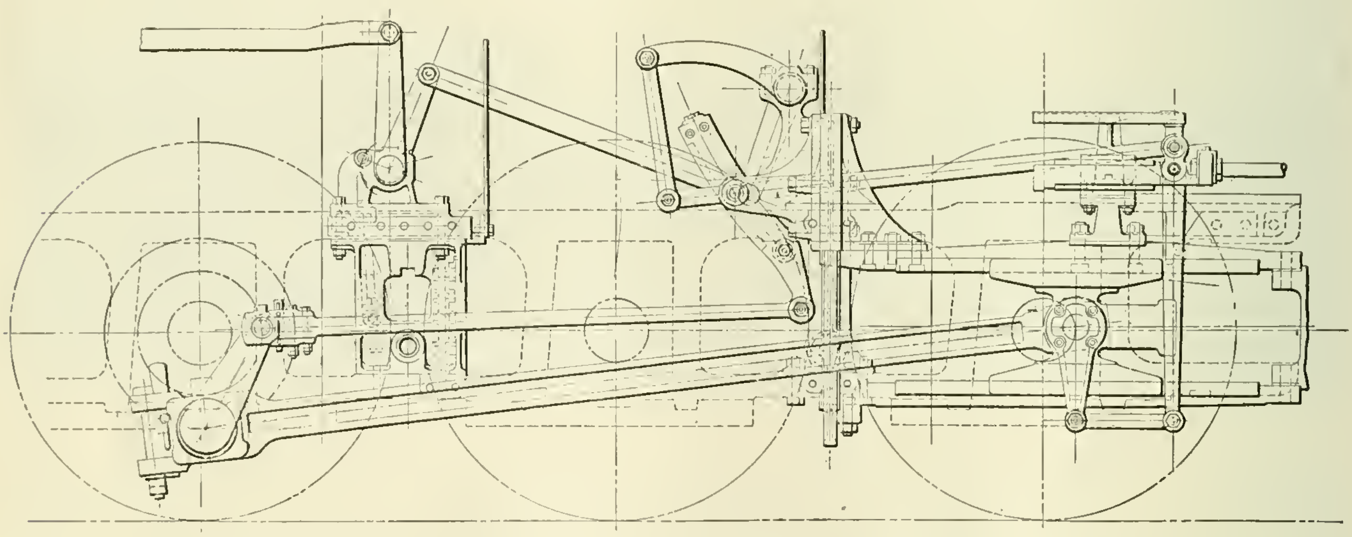
Articles have been published in a contemporary on the "Walschaerts Valve Gear" describing the construction and principles of operation, and giving reasons for some of the peculiarities in construction.

These articles did not conform to ideas set forth by some of the leading authorities on valve motion, and to me seemed to be very misleading to the majority of men preparing for promotion, where a knowledge of this valve gear was necessary. Note this quotation from the answer: "In the first place, the angularity of the main rod does not affect the travel of the valve, but the travel of the valve must be changed in order to overcome the angularity of the main rod" and the statement is made that the link foot being extended or bent back from the lower extremity of the link, changes the travel of the valve and overcomes the effect of the angularity of the main rod.

We will admit that the angularity of the main rod does not affect the travel of the valve, but on account of this angularity of the main rod affecting the travel of the piston as it does, were no other influence brought to bear on the movement of the valve, the valve would not be traveling in harmony with the piston, or perhaps a better way to put it, would be to say, that the valve would be traveling much slower (comparatively speaking) than the piston during the time the crank was moving from the front center to either quarter or from either quarter to the front center, and the valve would be traveling much faster, in comparison with the piston speed, than the piston, during the time the crank was moving from the back center to the top or bottom quarter, or from either quarter to the back center, the inevitable result being an improper distribution and expansion of the steam.

We have always been led to believe, through information acquired by studying the best authorities on valve motion, and instructions given by those versed in the proper methods of construction and application of the different valve gears, that to overcome this evil condition, and overcome or eliminate (so far as is possible) the effect of the angularity of the main rod, causing the valve to increase and diminish its speed to harmonize with the variable speeds of the piston during its stroke, that in the "Stephenson valve gear," the link is suspended to one side the center line of the link, and the same authorities inform us that in the "Walschaerts valve gear" the effect of the angularity of the main rod is entirely overcome and the valve caused to travel in perfect harmony with the piston, through having the connection made between piston (crosshead) and valve, with the combination (lap and lead) lever, which, fulcrumed on the radius bar, places the valve sufficiently under the control of the piston, to not only get the lap out of the way for the admission and give the desired lead at beginning of stroke, but also harmonizes the travel of the valve with the travel of the piston, giving the admission, cut-off, expansion and release at the proper intervals, and entirely eliminating the effect of the angularity of the main rod.

We would also like to have the authority quoted and convincing reasons given, for the statement that the link foot has anything to do with the elimination of the evils caused by the angularity of the main rod, because such authorities as Wood, Forney, Kennedy, Halsey and others whose writings are conceded the best on the subject of valve motion, have given us to understand that Egide Walschaerts' original design for his valve motion called for the connection between eccentric rod and link to be made on the center line of motion, to obviate possible evils resulting from the angularity of the eccentric rod. One good authority says: 'The variable movement of the crosshead—that is, the variable speed while making its full stroke, caused by the angularity of the main connecting rod, is transmitted to the valve through the combination (lap and lead) lever, thus, when the movement of the piston is accelerated or retarded, a like effect is produced on the valve, this tends to neutralize the errors in the events of the stroke."



WALSCHAERTS VALVE GEAR, SHOWING LINK CONNECTION ABOVE CENTER LINE OF MOTION.

A statement has also been made that "To equalize the expansion of steam in both ends of the cylinder, the link saddle stud is set back of the link center with the Stephenson gear, and with the Walschaerts gear the link foot, that is, the point where the eccentric rod connects to the link, is set back of link center."

A study of the best authorities on valve motion has taught us to know that the Walschaerts link is suspended at its exact

center, vertical and horizontal, and that the only purpose in extending the link foot down from lower head of link, is to make the connection between eccentric rod and link as nearly on the center line of motion as possible, in that manner reducing the angularity of the eccentric rod and its resulting evils, and the shape of the link foot, so far as concerns its extension back of the link center, is merely a convenience which makes the eccentric rod connection better and requiring a much shorter eccentric rod, than would be necessary were the link extended low enough to meet requirements in a direct line from its lower head, and by having a shorter rod the necessary strength is had with a minimum weight of material, furthermore the construction of many engines with the link suspended closely to the guide yoke necessitates this backward slope of the link foot for clearance if for no other reason.

It stands to reason that one end of the link slot must travel as far each way from its position when vertical, as the other end does, and the eccentric through its connecting rod must cause this movement of the link, and the eccentric rod must be of the proper length and the eccentric in the proper position, to place the link vertical when the crank is on either quarter, so what matters it if the link foot be sloped ahead of the link or in a straight line down from link or sloped back as is the present manner of construction, so long as the necessary weight of material is added to give the strength and avoid vibration in the longer rod made necessary by the distance between points of connection, to get the results in the movements above and below the trunnion centers?

Quoting an authority on valve gears, By looking at the Walschaerts valve gear it will be noticed that the position of the link is rather high in relation to the center of the main axle. Thus if the eccentric rod were connected directly to the bottom of the link, the rod would make a much greater angle with a line drawn through the axle centers when the eccentric was on the bottom quarter than it would when the eccentric was on the top quarter; in fact, there would be so much difference that the angularity of the eccentric rod would disturb the correct transmission of the motion. In order to reduce the effect of the angularity (of eccentric rod) to the minimum, the eccentric rod must stand about parallel with the line through the axle centers when the eccentric is on the dead center. To make this possible, the link is supplied with the link foot, to which the forward end of the eccentric rod is attached. If the link foot were long enough to permit the eccentric rod pin to be on the center line of motion, the vertical movement of the main driving axle in the driving-box jaws would have no effect on the valve motion. In practice the link foot is not made as long as it should be, to make the connection on the center line of motion, on account of making the throw of eccentric excessive, and in such cases an angularity of the eccentric rod results, and to overcome the effects of this angularity of eccentric rod and perfect the movements of the parts, the eccentric crank is advanced from the rectangular position in relation to the main pin, thus making the angle the eccentric makes with the main crank either more or less than ninety degrees depending on whether the eccentric follows or leads the main crank pin, the length of link foot will have an influence on the proper throw to be given the eccentric, the longer the link foot the greater the throw of eccentric must be.

We have never seen some of the misleading statements contradicted, consequently would like to have some one knowing the facts tell us if we are wrong in relation to the Walschaerts valve gear and put us right, because we are anxious to be right, and the above is our understanding of the principles involved in operation and construction of these parts of the valve gear, and until given conclusive proof that they are right and we are all wrong, shall continue to believe that the ideas set forth in these comments are correct.

We are open to convincing and conclusive statements that are clear and concise, but do not desire to be misled or misinformed.

We would like to have this article commented on and shown to be entirely wrong if such be the case, because there are many who desire to know whether we have always had the wrong ideas relative to the Walschaert valve motion principles. C. D. GEORGE.

Hoboken, N. J.

Pressure Reducing Valve.

EDITOR:

What do some of your clever correspondents think of the following: 'A locomotive with cylinders dimensioned for 160 pounds pressure, is fitted with a boiler adapted for 200 pounds pressure, with safety valves set at that figure. A reducing valve to be placed between the superheater and the steam chest connections. The reducing valve only allowing a maximum of 160 pounds to pass to the steam chests.

The advantages, I think, would be much less liability to blow off steam when making stops due to the fact that while running the steam pressure would probably be in the neighborhood of 160 pounds, and therefore 40 pounds more could be accumulated before blowing off could begin.

There would therefore be a reserve supply of steam when starting out with a heavy load, which would be a decided advantage, especially in climbing a grade. There would also be much less inefficiency due to unintelligent use of injectors. While there may be enough encumbrances on the locomotive already, and high pressure boilers are not economical, on the other hand there is much loss by blowing off steam, and any device to prevent this would be in the interest of economy.

WILLIAM J. LANDON.

New York, N. Y.

At Last a Direct Flow Locomotive.

EDITOR:

While the progress in marine and stationary engines has gone on apace in recent years, there has not been any great qualitative change in the building of locomotives with the exception of the heavy electric type, in a generation. This curious backwardness seems now about to end, if the adoption by three different European railroads is an index.

In the familiar locomotive that is to be seen on most tracks, the steam goes in through both ends of the steam cylinder and follows the course of the piston in its stroke. Then as the piston goes back and forth the steam reverses and is "turn about face." Thus the steam expands and becomes reduced in heat and is pushed out through the end of the cylinder that is used by the next inrush of heated steam.

The newly operated locomotive has what engineers know as the "stumpf system" of cylinders and valves. It is a valuable and startling innovation in locomotive construction. In this type there is little or no chance of any loss of heat by cooling, because the exhaust openings are in the middle section of the cylinder. Furthermore the cylinder is very long with a piston more or less resembling a drum. The European railways have already adopted a few of these locomotives and are now ordering more because of the economy of steam consumption as well as the fact that this variety replaces superheating, although superheaters are attached in all of these so far built.

The curious, drum-like piston is now built in this engine with spring rings at each end of the hollow castings. Valves on the piston admit steam and they have their longest stroke at 26½ ins. The locomotive for fast freight weigh as a whole 72 tons and its cylinders are four feet and eight inches long and one foot and eight inches wide. A series of holes around the cylinder walls which lead to a circular exhaust chamber allow for the exhaust. There is a ninety per cent. efficiency in the stroke each way.

DR. LEONARD KEENE HIRSHBERG, A. B., M. A., M. D. (JOHNS HOPKINS.)

Baltimore, Md.

An Engine That Was Tired.

EDITOR:

A Santa Fe locomotive, number 1367, left its track one day last month with the evident intention of invading an adjoining orange grove near Pomona, Cal., for a quiet nap. However, the big Mogul found hard traveling in the loose earth at the side of the tracks, and was

F. A. GIBBS, ENGINEER OF THE LOCOMOTIVE THAT TIRED.

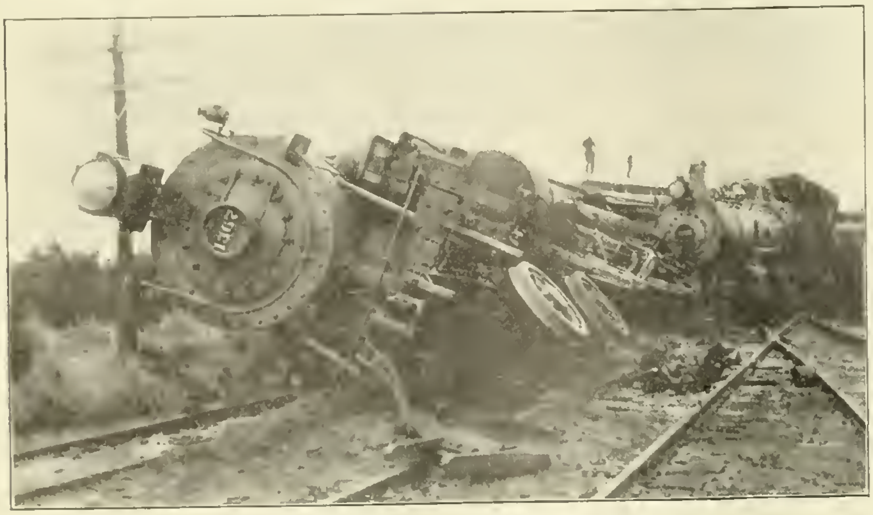
content to roll over and rest, half-buried, by the side of the tracks. Superstitious folk point out the big locomotive's poor success in its break for liberty in the number, the first two figures of which are 13, and the last two of which, added, make 13; a double "hoodoo" according to some. Engineer F. A. Gibbs says that the engine should not have needed a rest, as it was a quite new machine. A horseman suggested that perhaps the big Baldwin Compound was young and coltish.

Incidentally to the coltish frolic of this locomotive, its team-mate, following, was demolished with an express and two mail cars, while the adventurous leader of the escapade itself spent several weeks in the Santa Fe engine hospital at San Bernardino, Cal.

Not anticipating the little prank of their mount, which was traveling slowly at the time, Engineer F. A. Gibbs and Fireman Van Santford congratulate themselves that they did not share their engine's misfortune. Twelve coaches of Overland passengers also escaped injury from the vagrant tendencies that brought the twins of the double-header to grief. That the engines did not inflict their destinies of a double "13" upon the following train is due to the fact that Engineer F. A. Gibbs immediately applied the air brakes, and regardless of his own safety, assisted his fireman, Van Santford, from the overturning cab. The engineer and fireman of the rear engine leaped to the roofs of mail cars, as these passed them on either side. With a seeming uncanny mechanical cunning, the recreant locomotives effaced all trace of the means of their departure from the straight and safe right-of-way.

H. G. HALL.

Pomona, Cal.



SANTA FE LOCOMOTIVE RESTING BY THE WAYSIDE.

Public Safety and the Locomotive Boiler.

EDITOR:

It has always taken some fearful calamity such as the Iroquois Theater fire, the loss of the "Titanic" and the great floods in Ohio, to arouse the public to at least a partial appreciation of the dangers they are daily facing in an indifferent and almost unconscious manner.

Why continue along these same lines? Why should we not look around us and arouse ourselves to these risks and use our endeavors to have such laws, both local and federal, as will prevent, so far as possible, similar disasters from other sources.

We cannot longer call these *accidents*, for they are in nearly every instance preventable, and as soon as a law is put in the statute book holding corporations and others directly responsible for all such disasters which could have been prevented with proper and reasonable foresight, so soon will each of us be able to go about our various avocations with that feeling of security which we have every right to demand.

The writer's attention has been called to the published reports of locomotive boiler explosions which have occurred on some of our largest and most important railways.

While in several instances the property damage due to these accidents (?) has been very considerable, the loss of life has been small. The public, therefore, remain in a semi-torpid and disinterested condition, and apparently it will require some terrible catastrophe such as previously referred to, to awaken them. It has been suggested that such an explosion is likely to happen at any moment in one of our large terminals: Are our railroad officers going to wait until this happens before they make some determined effort to find a remedy? Are our legislators going to sit calmly in their seats waiting until a large number of the traveling public are killed, before passing laws compelling safer construction of boilers?

That the present design of locomotive boilers is no longer safe is a matter of public admission by our railroad mechanical people—both designers and practical boiler makers, yet they continue to put this same design of boiler on new construction.

Several engineers have been working on improved designs and some of these have been sufficiently tested to make them worthy of more extended trial.

The writer has had a large and varied experience on steam railways and has been called upon in a number of instances to pass an opinion on boiler explosions. He is also fairly familiar with the history of explosions and the various tests, etc., which have been conducted to determine the causes; and it is his conclusion that the trite excuse usually given the public of "low water" and the placing of responsibility on the engineer, is about worn out; our mechanical engineers and motive power officers should try something else.

It is pretty well known that our railroads have spent hundreds of thousands of dollars in experimenting and trying out the ideas of their mechanical people, and will probably continue to do so, no matter how impractical many of these ideas are. But when an outsider attempts to improve or better designs, even though his experiences along the special line may be much greater, he usually meets with opposition. There are various reasons for this:

1. He is an outsider.

2. His design may be good and the mechanical officers may readily approve of

it, but it might mean an additional first cost which the superintendent of motive power would have to give excellent reasons for entailing, especially when legislation has greatly increased maintenance problems.

3. Many railroad mechanical men are thoroughly capable of working out excellent designs if they had time, but are so occupied with administrative matters that they are prevented from doing this and are afraid that the adoption of an outsider's design will be considered an admission of inability.

4. Some of our best motive power officers are not designing engineers and never pretended to be, and the designing is frequently imitation and copy, or is left entirely to the large building firms.

5. There are, here and there, men who cannot see the value of anything unless they own directly, more generally indirectly through friends or relatives, stock in the enterprise. I believe this class is gradually becoming smaller, but there are a few left yet.

6. It is the writer's opinion that, as soon as the public, through their representation, both state and national, demand safer locomotive boilers, they will obtain them.

There are several designs on the market today which give evidence of marked advance in the way of strength and safety; among these, the corrugated and balanced type which has been tried on the New York Central Railroad. This particular design of boiler has met with the approval of some of the very best designing engineers, as well as the practical boiler makers, and the tests on the New York Central Railroad seem to fully justify the belief that this design or one along similar lines will eventually be adopted. It is hoped that it will not require a boiler explosion in one of our large terminals, with the accompanying loss of life, to bring the public and their representation to a more earnest consideration of their great responsibility in this matter.

H. A. Gillis, M. E.
Washington, D. C.

Extension Car Step.

Editor:

At the recent M. C. B. convention held at Atlantic City, the exhibit in booth No. 329 seemed to appeal to all who took the time to look into the workings of "The Crofut Extension Car Step" being shown and demonstrated by the inventor, Mr. U. E. Crofut, of No. 1508 Schlager Boulevard, Scranton, Pa.

Mr. Crofut has been in the passenger service on the Lackawanna R. R. for over twenty years, and has given considerable thought to the safety of passengers, as well as the liability of the company, and realizing the many possibilities of accident and injury obtaining with use of the old stepping box, has, after a trial of his invention on Lackawanna car "B" for a period of twenty months, without a single failure in operation, decided to place the step in service on several of the leading railroads.

On inspection of the step the first impression is favorable on account of its simplicity and durability, and one of its

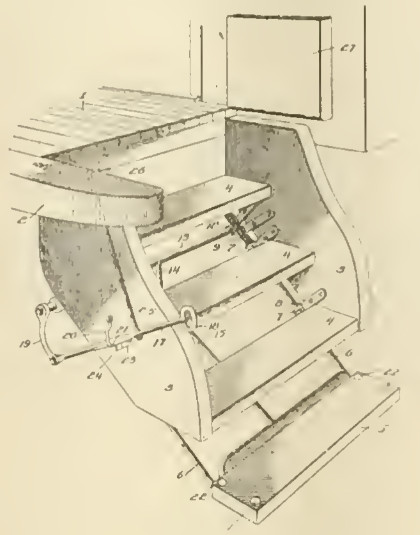


FIG. 1.

most important features is that the step can never be put down by the trainmen or traveling public while the train is in motion or before the train is stopped, thus avoiding the possibility of damage to the step by an obstruction along the track before the train reaches the station.

Another good feature lies in the fact that the step cannot be made to stay down

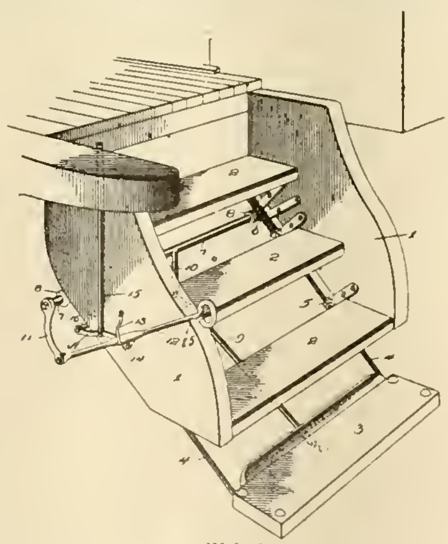


FIG. 2.

when the trap door is closed, the trap door being seated on latch when closed allows step to automatically go up underneath the lower step on car, and it is necessary for the train to be stopped before the trainman can step to the ground and pull the lever on side of step which adjusts the step for use.

After the trainman has loaded his passengers, by knocking the lever off of latch, or shutting the trap door, or putting his foot on the foot-latch on open cars; the reaction of the compressed springs on the slide rods, which are adjusted to a tension of about 12 or 14 pounds on a side, draws the Extension Step up under the lower coach step to its riding position, resting on two rubber knobs which keeps the steps separated so they will not freeze together in the winter.

On account of the tension of the springs, which must be compressed to put the step down, if anything got out of order the step would stay up.

Cut number one shows the step applied to the vestibuled car and cut number two shows it applied to the ordinary open car, the construction and operation being the same, except that the trainman must trip the latch on the open car, by putting his foot on it while the trap door does the work on the vestibuled car.

J. A. Baker.
Scranton, Pa.

Derailment.

Editor:

In the April number of Railway and Locomotive Engineering, page 125, in a short article I stated the trouble I had had with a consolidation engine by derailment. As stated before, this engine was delivered to me direct from the repair shop. It was about midnight when I received and took charge of her. The engineman that made the delivery reported everything correct except that the back driving box was warm. I started with her to the laying up place half a mile distant. I noticed the left back driving box was stuck. As we had about six hours to lay up I thought when the box cooled I would pull the wedge down to release the box, but when I went to do this I noticed the wedge was then down on the pedestal brace. As we have but one engine and it was necessary to make a run that day I gave the box a thorough oiling and started on my run. The first curve I passed through the box stuck and just as soon as she got on straight track the back driving wheels left the rails. I have been running this engine over this track for ten years. She never did this before and, in fact, I had never thought a stuck driving box would derail an engine. After a number of derailments I did the only thing I could do under the circumstances: slacked off the back end of pedestal brace to lower the wedge and release the box. When I got back to my terminal I sent the wedge to a shop 50 miles distant and had 1/16 inch planed off of it and I have had no further trouble. I am of the opinion that many derailments have been caused in this way.

Fred Niho f.
White Sulphur Springs, W. Va.

Brighton Works of the London, Brighton & South Coast Ry.

BY HUGH G. BOUTELL.

While in England last fall I had the good fortune of being able to visit the

BRITISH TANK EXPRESS LOCOMOTIVE AND PULLMAN TRAIN.

main shops or "works" of the London, Brighton & South Coast Ry., located in the town of Brighton, one of the most famous watering places in England. My visit proved one of the pleasantest I have ever made and if the treatment I received from the officials at Brighton is any indication of what an American may expect in visiting the establishments of English railways, I wish I could have inspected the establishments of all of them.

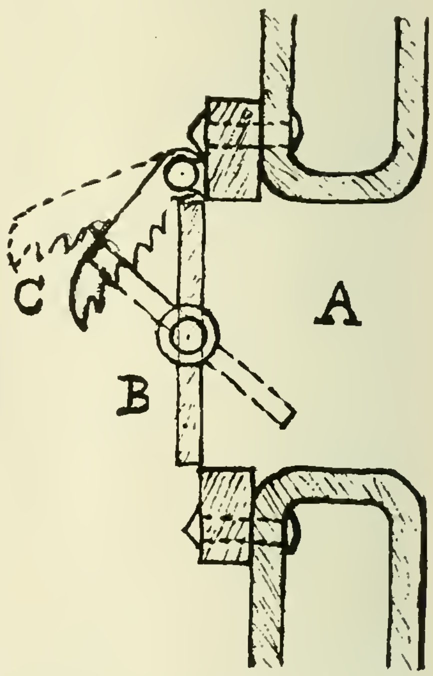
In the first place, let me state that I didn't take this trip with the idea of gathering a great number of figures, which would be used in an article showing the inferiority of British railways compared to those in the United States, but merely to get a few general impressions, and in this I was successful.

The Brighton Line, while one of the smaller system, has a very heavy passenger traffic and I suppose its practices may be taken as fairly representative of other British roads.

The shops are rather small, but seem well arranged, and according to the usual English practice, turn out everything the roads uses, from an oil lamp to a complete locomotive. Just how economical this is I am not prepared to say, but it certainly is different from American practice. A large percentage of the work is still done by hand. For instance, in the foundry a manual crane is used, my guide informing me that it permitted more accurate pouring than could be done with a power crane. I also noticed some men making hand-made nuts, while on the other hand, there are some large motor-driven wheel lathes, a large steam hammer, etc. In the foundry I noticed a pair of inside cylinders being cast, with the steam chests beneath the cylinders. A plain slide valve is used and this simply drops off the seat while drifting, thus saving wear. It also allows a ready escape for water of condensation. I also noticed some fine looking crank axles, made in one piece, and beautifully done. I understand that they have very little trouble with these over there. I believe a chrome steel is used for this work. In the erecting shop I got a good idea of the plate frame, as used in England, and it's a rigid looking proposition, I can tell you. This road has no Bellpaire boilers in use, and only one engine with Walschaerts valve gear, 4-6-2 tank express, No. 326. My guide spoke favorably of the gear and also said that the road was going to try the Bellpaire firebox on one of the smaller engines. The tin and copper-smithing shop was unlike anything we have at home and very interesting. They hammer out dome casings by hand and at one time used copper caps on the smokestacks, but these proved too expensive, and the present standard stack is made of cast iron.

Fireboxes are all made of heavy copper, and an American can't help wondering how the staybolts can stand the strain when the steel outer sheets and the inner copper ones start off according to their different co-efficients of expansion, but apparently they have very little trouble.

After visiting the shops proper we spent some time in the engine houses, which are large and where light repair work is done. The houses are very long, with two or more parallel tracks and a long wooden smoke duct over each track. I cannot see how such a shed can be as convenient as our form of round house, as to get at an engine in the middle of the house, five or six other engines would have to be moved. We got up in the cab of one of the engines and I noticed much that is different from American practice. The engines are all "left-handed"; that is, the controlling levers are all mounted on the left side of the cab. The throttle or "regulator," as they call it over there, is mounted on the back head and has a double handle like an injector steam valve, and like the latter, it turns instead of pushing back and forth. The throttle rod (or really stem) stuffing box is carried by a brass fitting which also forms the base of the whistle pipe, the whistle itself being on the roof of the cab. The brake valve and lubricator are bolted to the cab wall, and the air gauge is on one side and the steam gauge on the other. Some of the engines have a duplex steam gauge showing boiler and steam-chest pressures. Reversing on the passenger engines is done either by air or a screw hand gear, while switch and, I think, freight engines have ordinary levers. The screw gear has a graduated scale and pointer to show the cut-off, and quite a complicated arrangement for controlling the air piston. There is a band brake, operated by air, on the reversing shaft which keeps the gear from going too fast. The engines have a very neat form of furnace door, somewhat like the accompanying sketch.



SKETCH OF FURNACE DOOR ON BRITISH LOCOMOTIVE.

The door A has a large opening in it, closed by the damper-like door B. When firing the main door is not opened, the door B simply being pushed in by the shovel, and it is held open by the ratchet C, which can be knocked off again with the shovel, thus closing the door.

Several means of feeding the boilers are used. Some engines have cross-

head pumps, some steam pumps mounted on the boiler and closely resembling an air pump in appearance, some at tandem driven water cylinder connected to the air pump, others regular injectors and still others, express engines particularly, have exhaust injectors. I don't see why these are not used over here, as they must result in quite a saving of steam. Where the tandem driven air and water pump is used provision is made for shutting off either the air or water cylinder when desired.

On the front of cab, over the boiler head, are painted the names of the engineer and fireman and these men and no one else run that engine, the way it used to be in this country.

The road has quite a variety of types of engines, among which the smaller styles predominate. There are a few "Atlantic" types, several large tank engines, etc., but the majority are small. The most peculiar ones I saw were a class of 0-4-2 express engines, used until recently to haul the fastest trains. They are inside connected and very neat looking. The use of these engines seems a direct contradiction to the statement so often made that an engine without a leading truck is unsafe at high speeds. There are also some interesting little 0-6-0 tank engines, built about 1872 and now used for so-called "motor-car" trains, that is one or two light cars for suburban work.

The latest engines on the road are two large 4-6-2 tank engines Nos. 325 and 326, built at the works in 1910. They are identical except as to valve gear, No. 325 having the ordinary link motion and the other Walschaerts gear. Some of the newer engines have Schmidt superheaters and they are said to be satisfactory.

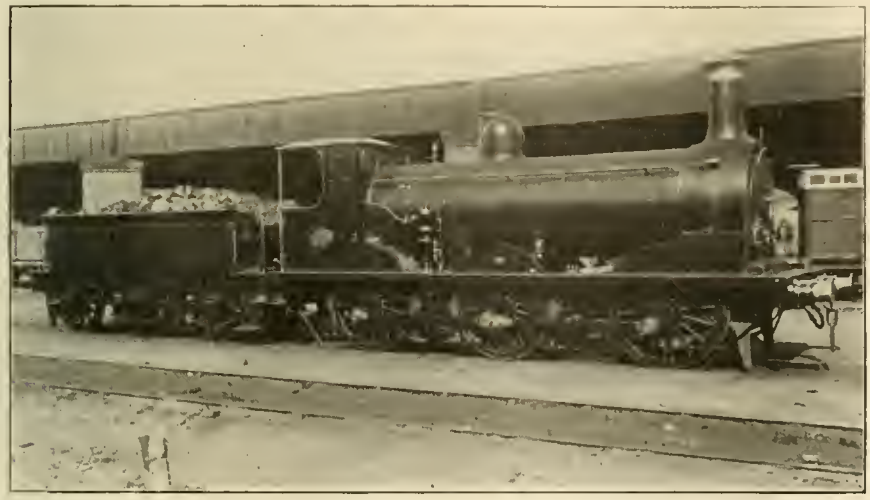
Freight or "goods" trains are hauled by 0-6-0 engines, inside connected, with separate tenders, a type peculiar to the British Isles, and switching is mostly done by 0-6-0 type of tank engines.

To some one used to the severely plain looking and often poorly kept up engines of American roads it seemed good to see these carefully looked after and handsomely painted machines. But then, the average Englishman takes a lot more interest in the railroads of his country than we do over here. He knows the name of the engine that hauls the "nine o'clock down" as well as his own name, and would probably make quite a fuss if the engine was not kept up in good shape. This attitude on the part of the public is reflected in the attitude of the roads themselves, and results, I think, in better feeling all around than generally prevails in this country.

The road runs some splendid express trains, on most of which Pullman service is provided. These parlor cars are similar to ours, only smaller. Some have narrow and some wide vestibules and they are beautifully finished inside and out. They have a very odd look when coupled up in a train of regular English cars. We finally finished up in the drawing rooms where I saw some beautiful examples of the draughtsman's skill in the shape of tinted drawings showing sections of boilers, complete locomotives, etc. I thought this was a lost art and it surely is in this country, but apparently is still practiced in England.

In closing let me say that, while as a general thing, I don't think there is much use in comparing the railroads of two countries, due to the great difference in conditions, I do think that American roads might still learn a good deal from the smaller but older systems of Great Britain.

I wish to thank Mr. Edward Haile particularly for his kindness in showing me through the shops, and I may add that the uniform courtesy shown by British railroad men to visitors is of the best.



TYPICAL BRITISH 6-WHEEL GOODS LOCOMOTIVE, SHOWING TANDEM WATER CYLINDER CONNECTED TO AIR PUMP.

Want Engineers in Politics.

The engineering profession holds a very high place among British public men, but very few engineers are employed by the government. The London *Times*, which is a good representative and leader of public opinion, wants this changed. A recent editorial in that influential paper reads:

"At a social gathering a few weeks ago a distinguished official of a government department expressed surprise at the fact that so few technical men are employed in the civil services of the State; and he ventured to predict that there would be a distinct gain to the country if experienced engineers and chemists were brought more closely into touch with its administration. The events of the last few years have accentuated the need for exact quantitative knowledge of machines, structures, and materials by the departments controlling their use, and it cannot be doubted that, sooner or later, an increasing number of qualified engineers will be requisitioned as permanent officials. Meanwhile the question of the status of engineers, in comparison with that of members of the legal and the medical professions, is being earnestly discussed, both here and in the United States; and the relative claims of the lawyer, the doctor, and the engineer to administrative powers, fees, and distinction are being subjected to careful examination. Lawyers may be said to have annexed the House of Commons, and the remarkable performance has lately been witnessed of the coercion by them of the medical profession. Before a similar process is put into force in respect to engineers, it is desirable to consider the reason of the lack of balance which has brought about this subversion. It is largely a consequence of the fact that, while the legal profession studies how to obtain control, the other professions take little interest in public affairs. A remarkable list could no doubt be drawn up of engineers who have been statesmen, but it must be confessed that engineers as a class stand aloof from the dull mechanics of modern politics. It is unlikely that engineers in this country will follow the lead of the section of the profession in the United States, which is contemplating the establishment of a vast union to control all designs, details, and engineering labor, but something requires to be done by them to set their house in order. In other words, if the status of the engineering profession is to be upheld, the profession must be more effectively represented in administrative affairs than at present."

A step further might be taken and the introduction of a larger number of men in our legislatures who are familiar with railroad operations would, we are certain, be productive of more benefit than the supply of noisy legal fledglings.

General Foremen's Department

General Foremen's Convention.

The ninth annual convention of the International Railway General Foremen's Association commenced at Chicago, July 15, President F. C. Pickard in the chair.

President Pickard thanked the officers and members of the association for the strenuous work they had done towards making the convention one of history.

The work of the General Foremen's Association, he said, has been far reaching, well defined and its benefits appreciated by all and the work of this convention will place it at the top with other mechanical conventions.

By mutual discussion of the many subjects that come before the convention and the benefits gained by convention work, your attendance is profitable to yourself and to your company. It not only affords an opportunity upon the floor of the convention, but opportunities for exchanging ideas outside the convention hall which bring valuable practical information. We are able to talk to our associates on various matters that bring enlightenment and progress, acquiring information of results obtained by our neighbors after exhaustive experiments. You in turn ought to offer something that will be of benefit to them.

The man who tries to keep all his own trade knowledge ought to remember that he has no right to the ideas of others if he is stingy with his own. The man who is doing the little things today will be doing big things tomorrow.

As general foremen we should be able to make an analysis of our local conditions and surround ourselves with the proper organization to meet the requirements of proper shop management. Organization is recognized as an economical necessity to effective control and co-operation in human effort. Organization deals with men and industrial organization includes the elements of production and transportation.

The various committee reports are matters with which the general foremen are daily coming in contact. By liberal and exhaustive discussion of these reports, you will be assisted in arriving at just conclusions as to the proper and economical way of handling important matters.

We should consider carefully the recommendations of the various committees and avoid lending the prestige of the association to anything likely to increase cost of maintenance and shop operation.

MR. ROBERT QUAYLE'S ADDRESS.

A most interesting address was next delivered by Mr. Robert Quayle, general superintendent of motive power of the Chicago & North Western Railway, who is a ready and most eloquent speaker.

The address was devoted mostly to the elements which contribute most largely to success in life. First he placed character as the most influential force in elevating people from a humble to a high rank in life. Without sound character the ordinary person's ambitious efforts came to nought. There are exceptions to this rule, but they are the exceptions that prove the rule to be sound.

There is not much genius in the world. It is hard work that counts. Apply the things you go after and apply them hard. Somebody said to Thomas A. Edison, "You are a genius and you have inspiration." "Yes" was the reply, "two per cent. inspiration and 98 per cent. perspiration."

You cannot live in the past today. Those whose ideas run that way have no place in modern railroad life, because if there is any place that particularly needs applied mechanics and applied intelligence it is on the railroads. It is not what you know, it is what you do that counts. Then let us be up and doing, and doing with all our might.

The efficiency that results in low operating expenses is attained by constant vigilance and hard work. The cost of operating keeps increasing, then Locomotive Engineering and others like my friend, Dr. Sinclair, call our attention to what it cost last year and they want to know the cause of the increase.

The remainder of the address turned mostly on efficient work and the duties of general foremen in that regard. We hope to take up Mr. Quayle's remarks again.

Reports of Committees

Superheated Locomotives.

Mr. P. C. Linck presented a report on superheated locomotives, giving a mass of information carefully collected during personal experiences with locomotives using superheated steam. The report emphasized the absolute necessity of keeping the flues and superheater units clean and recommended that the superheaters should be tested with warm water at a pressure of about 100 lbs. This test should be made to correspond with the monthly stay-bolt test, and should include the boiler seams, and flues in front flue sheet should be carefully examined for leaks, all joints in the superheater steam pipes, rings, exhaust pipe, all joints to steam header, also for cracks or break in header, and particularly the unit pipes below the ball joint, as this is a point where the most trouble is experienced. Rings should be made of a good grade of cast iron, as brass rings deteriorate rapidly. Trouble has also been experienced with the superheater unit pipes, generally at the back end nearest the fire. Dummy couplers furnished by the Superheater company are well suited for temporary repairs.

The earlier troubles with valve bushings, valve and cylinder packing, had been overcome by adopting the Hunt-Spiller gun metal for these parts. Valve packing should be cut ⅛ inch large, cut out the proper amount, then a jig should be used for compressing and turn off the packing the exact size of the valve chamber. Semi-plug piston valves had done excellent service. In regard to piston heads good results had been obtained by using a composition of copper, lead, tin, zinc and antimony, applied to the bottom of the piston head. Piston heads reinforced with this composition did not show more than 1/16 inch wear in three months.

The lubricator should always be started before throttle of engine is opened as it will take from ten to fifteen minutes for oil to reach the end of the pipe. A steam pipe should also be connected from the boiler into the lubricator oil pipes, so that the engine while drifting would have a flow of saturated steam with the oil, thereby preventing the carbonizing of the oil.

The superheater flues should be beaded in front flue sheet. The baffle plates should be made to fit tight and should be so constructed that they can be removed without removing the door ring.

A level fire, as thin as conditions will permit, and kept at a bright white heat over the entire grate is recommended. Not more than two gauges of water should be carried. In the absence of what is known as the booster valve, the throttle should be slightly cracked when drifting in order to carry the oil to the valves and cylinders as well as preventing air from entering the cylinders. About 25 per cent. more oil should be used with a superheater engine than a saturated steam engine of the same size and in the same service. A full throttle is recommended wherever possible, and

the lever gradually hooked back till the most economical point is reached, which is about 25 per cent.

Engine House Efficiency.

A comprehensive report on the above subject was presented by Mr. W. Smith. chairman of the committee. The report clearly pointed out the fact that efficient locomotive performance is largely determined by the engine house. Many desirable features were recommended for promoting efficiency in the engine house, such as boiler checks with shut off valves, attached, which make it possible to grind in checks with engines steamed up, and syphon cocks located on the dome for conveniently blowing off steam. Pistons with long rods that can be pushed far enough ahead to renew cylinder packing, without cutting rod loose from the crosshead, are also to be commended. As a move in the right direction, locomotives are being turned out of the locomotive works at the present time, with an auxiliary dome or manhole cover which makes interior inspection of the boiler possible without removing the throttle standpipe.

Round house kinks and handy devices when developed to meet the existing condition of power are great time and money savers.

A large number of failures occur from hot bearings—especially in high speed service. As a preventive measure, engines should be equipped with a water line, and when new brasses have been applied to engine truck, tank, or trailer journals, the engineer should be notified to that effect by a suitable tag tied to the throttle.

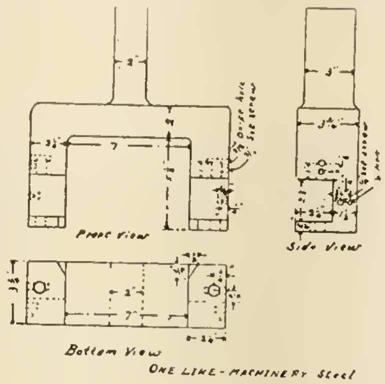
Other work that is performed periodically at different engine houses consists of removing drawbar pins each month for inspection: cleaning out tanks each month; draining main air reservoirs each week; gauging height of drawbars and pilots each week; examining piston nuts and follower bolts of built-up pistons each month; testing air brakes each week; examining smoke box draft arrangements and ash pans each week, etc. When periodical examinations and tests are made, it is very important that a suitable record should be kept of each.

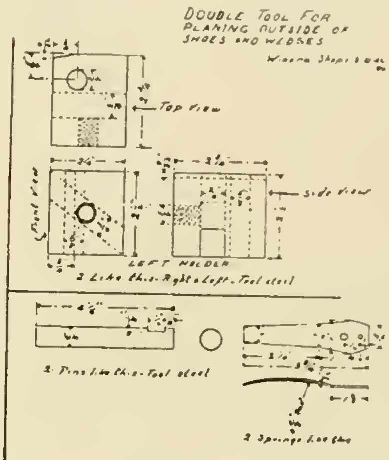
In order to get highest efficiency, work should be specialized as far as consistent. Of course the size of the engine house will determine how far this system can be carried. When work is specialized, the special men most generally have the special tools required, and are thoroughly familiar with the work. In large engine houses there should be special men assigned to such work as rods, valves, air work, cab work, and so forth. In choosing specialists some attention should be paid to individual proficiencies.

Mr. Smith further presented an excellent plan of shop organization, besides plans of operating boards and other facilities, and it may be said briefly that the excellent paper covered the entire field of operations in relation to an engine house.

Driving Boxes and Driving Box Work.

Several important papers were presented on the above subjects, and many examples were given of the methods of operation, and in general there was shown in the reports many valuable hints pointing out the avoidance of moving the work from place to place, which is a common practice in many shops. As an illustration of improved methods it was pointed out very clearly that at the Winona shops of the Chicago & North Western Railroad, they have an ideal layout for driving box work, etc. This was planned and carried out under the supervision of Mr. Chas. Coleman, master mechanic at that point. The plan was shown in detail in a sketch. The principal item taken into consideration in locating the machines, in addition to having them convenient for the work, was to eliminate all the trucking of parts possible, and the experience of ten years' demonstration proves that the objects sought for have been very fully attained, and from the time a driving box, piston, crosshead, or rod arrives for repairs, it is never placed on a truck or any other conveyance, unless it is necessary to send it to the blacksmith shop or if it needs some unusual repairs.





Driving boxes, if old, when taken off wheels, are loaded on dumpy and taken to lye vat, returning by way of transfer table engine hoist track, and track in center of shop, and placed along side of planer near slotter, from which point they are handled by crane; first to hydraulic press, to have brass removed; second to planer; third to babbitt fire and are then (if old) picked up with hoist on runway and drilled on 36 in. drill press. If boxes are new, they are removed from planer with crane attached to wall and drilled on gang drill press, and then placed for babbitting by use of the two cranes. After babbitting the boxes are bored, the saddles and cellars are fitted and are ready to be taken to the wheels for fitting on axles. Groove is turned in outside of brass for shoulder after which brass is slotted on outside for box fit ready for pressing in, special tools for calipering being used.

Special tools are used for planing driving boxes and shoes and wedges and four surfaces are planed at one time, except on wedge and jaw face, when two only are planed.

In regard to frame jaws the work should be well done. It is not necessary to spot face of jaws to a face plate and then grind to make steam tight joint, but we should insist upon a general bearing and consider the time well spent in making it. The "good enough" habit which has become so prevalent among railroad shops, has made many an engine a shop candidate while undergoing repairs.

Top of frames should be level over jaws, which will indicate jaws correctly aligned—if humped, jaws pulled together—if swayed or depressed, jaws spread apart. The symptoms are so apparent that it is easy to diagnose the disease and apply the remedy. Insist upon frames being level; it only takes a few moments to check with straight edge and you may keep a frame from fracture by so doing.

The removable brass feature, permitting the renewal of same without the usual dropping of wheels has proved to be a big time saver. At Clinton a front brass on Atlantic type engine is removed and new one applied in three hours—main brass on same type engine with Stephenson motion, necessitating the moving of eccentrics, is removed and renewed in from five to six hours. With Walschaert, or outside valve gear, main brass is as accessible as front and can be renewed in same time.

In regard to repairs to second-hand boxes, Mr. C. S. Dickert presented a brief description of the methods that had come under his observation and were as follows:

When wheels are removed from engine

the boxes are knocked off of journals, all grease or dope taken from boxes and cellars and sent to oil house to be reclaimed. Boxes are placed with other parts removed from engine in a large basket and sent to lye vat to be cleaned, which is done with labor gang in erecting shop. After cleaning, boxes are taken to driving box gang who examine brasses, boxes and cellars. If the brasses are tight and thick enough to be planed again they are not disturbed; if they are thick enough to use and are not too loose in box we tighten them with tin shives; and if they cannot be used again they are pressed out, broken up under steam hammer, to be melted and poured in boxes for hub liners. New brasses are fitted to boxes and pressed in. Copper lugs screwed in hub face of box, they are sent to copper shop for hub plating. Next move to shaper where they are straightened up, shoe and wedge face. Cellars are next re-fitted and they are ready for boring mill to be bored for journal. This finished, they are delivered to engine.

Tools in this group consist of planer, shaper, slotter, two boring mills, drill press, hydraulic press and two work benches. Pneumatic hammers are used for all chipping. The brass furnace is within reach of the jib crane that serves this group. The crane is provided with air hoist for handling work, which makes it very convenient for transferring boxes from one machine to another with one man. This group has two 30-ft. jib cranes for serving, and in addition to jib cranes we have a 30-ton electric driven crane the entire length of machine shop for any transferring of material necessary.

Mr. C. M. Newman also presented much valuable information on the same subject, and gave in detail many descriptions of methods that had come under his observation. On the subject of squaring the engine, Mr. Newman claimed that there should be a point to start from. If the engine has a lead truck it must first be made square and set central between the frames and cylinders as it controls the tracking of the engine. It matters not how perfectly square we have our driving wheels, the engine will not track properly if the engine truck is not properly squared and located.

As we have set the lead truck central between the frames and cylinders, we should use this same point to set the driving wheels. From this point a square center is found on the frames, generally at the main pedestals. From this center is located a center for the main boxes, governed by the thickness of shoes desired and the length of the main rod. The main box centers located, the other box centers are located from them, the length of the connecting rods determining the distance between. Of course each set of side rods is made the same length or a standard length for each class of engines.

With all the centers located, and as the boxes are bored central, it is only necessary now to get set lines on the shoes and wedges for the planer. This is generally done by dropping a perpendicular line from the main box centers and locating two points on this line, a certain distance from the top of the pedestal. From this point, strike an arc on the flange of the shoes and wedges, using a radius, generally 1 in. larger than one-half the width of the box at the shoe and wedge fit. Transfer one of these centers to the inside of the shoe, and use the distance between the outside set centers to locate the center on the wedge. These points on the shoes and wedges are the same distance from the top of the pedestal as the points on the perpendicular line. The main shoes and wedges are laid off for planing; it is only necessary to transfer these set lines or points to other shoes and wedges, using the side or connecting rods to determine the distance between.

Shop Schedules.

Mr. Henry Gardner, supervisor of apprentices, on the New York Central & Hudson River Railroad, presented a report on Shop Schedules, taking for his model the system in operation at the West Albany shops of that road. It may be mentioned at the outset that scheduling means listing in order of dates or naming in consecutive order, and providing a proper predetermined date or day of the month when each part or group of parts, will arrive at and depart from the various departments comprising the path over which each part will travel until they are finally placed in proper position on the engine. In most railroad shops the date for the delivering of the entire engine is all that is planned ahead, but it is just as necessary to plan ahead a date for the cab and wheels or other parts. If this is not done confusion will arise, especially in the larger shops, and a delay in one department will counteract the good work of all of the other departments.

The first requisite is route sheets showing the course of all the material to be scheduled through the various departments. The second step is to determine accurately the number of days to allow the work to be done. In some shops this is mere guesswork, but it will be found that as soon as a proper schedule is in operation the time for repairs will be much shortened. The fact that comparatively few engines undergo exactly the same amount of repairs, it is necessary to formulate a key or master sheet representing the number of days allowed for each operation, and from which, by a little experience, the schedule for the special engine in hand will readily take proper shape. About 25 forms are at present used at West Albany. These are the outgrowth of experiments. Auxiliary cards or "ticklers" as they are called are also used. These convey to the foreman or other official in charge each morning an exact list of what should be finished or delivered on that day.

Too much importance cannot be attached to the proper supervision of the engine when stripped since the list of scheduled material depends upon the report made by the stripping gang foreman who should see that no unnecessary parts are removed and should make careful notes as the work progresses stating which parts should be repaired or renewed. This record should be sent to the schedule office and from it the repair cards will be made out. No repair card can have the full confidence of all concerned unless it is based upon exact conditions. The master mechanic's report of repairs necessary should be made out and sent to the shop superintendent as usual and while the engine is still in service. An elaborate detailed report is not necessary since the full extent of the repairs to be made can only be accurately determined after the engine has been stripped.

Since the establishment of the schedule system a bitter feeling prevails in all departments. Men are not unexpectedly called up to work at night. The piece workers like the new system because they now get more work and it comes in regular order. Even the slow workers prefer it and earn more because the incentive of meeting the dates stimulates them beyond their normal output. The general foreman's duties are less complex, and a kindlier feeling is apparent in the manner of the foremen and workmen toward each other.

The aim of the largest percentage of the railroad shops today is, to turn out the largest output of good work in the shortest possible time. This can be done by the use of a schedule that can be altered by the shop management. Quite often to give any special engine preference means the loss of two or more deliveries that could have been completed had the work been allowed to go along the regular channels.

Apprenticeship.

The subject of apprenticeship was reported upon by a special committee, of which Mr. F. W. Thomas was chairman. The report stated that from the information received it is evident that the subject of apprenticeship is attracting considerable attention, and there has been a substantial development in the work. In addition to the larger and more prosperous railroads in the country, nearly all of the large industrial concerns have instituted

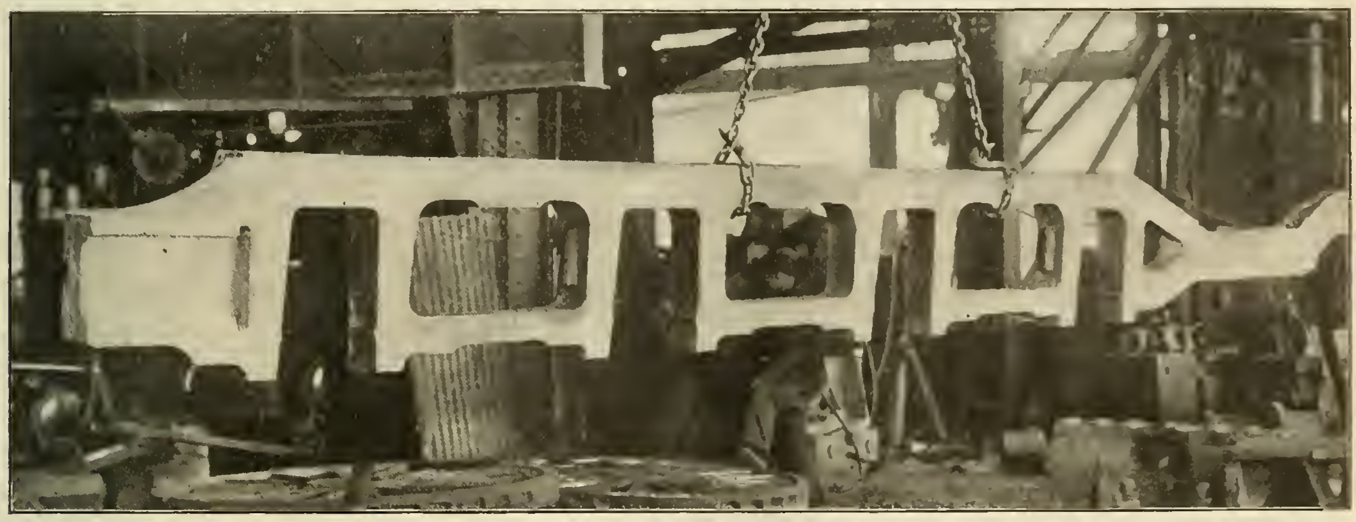
educational courses, some of these have regular apprentice schools, others co-operate with the public schools in the continuation schools or part-time system and still others have made arrangements whereby the men whom they are training may receive instruction through the correspondence schools or Y. M. C. A. schools. These courses are offered to their employees not only by the large corporations making railway supplies but by the large department stores, etc.; even large banking concerns organizing schools to train men to handle their auxiliary organizations such as Gas and Electric Power Companies, Street Railways, etc. Many of the men trained by the large supply companies go out and work for the companies purchasing their supplies. In addition to teaching these men subjects relating directly to the needs of their respective organizations, they also teach character building, politeness, and the ability to "get along." Probably some 200 corporations are now offering their employees educational advantages paying them for the time spent in school. They would not be doing this if it did not pay them in dollars and cents.

The committee urged the necessity of having adequate instructions for the shop and not merge the boy's education with the school room work. While we recognize the great value of the school room instruction, we believe the one should supplement the other. The principal objection offered by Foremen to apprentices in the shops is the time which must be spent with beginners. With adequate shop instruction the Foreman is relieved of this. The boy is given assistance as soon as he enters the shop and is made productive at once. It has been demonstrated that where you have twenty apprentices in one trade in a shop the increased output of the boys brought about by a practical instructor, will amply justify the services of an instructor.

Vanadium Cast Steel Frame

The increase in the number of the heaviest kind of locomotives equipped with vanadium steel frames is the best proof of the fact that the serious problem of frame breakage has been successfully solved with the introduction of vanadium in cast steel locomotive frames. Reports from several of the leading railroads show an almost complete absence of frame fractures where vanadium steel has taken the place of carbon steel. As is well known carbon steel is subject to rapid deterioration, especially when subjected to intermittent shocks and stresses. When rolled or hammered it assumes a fibrous or stringy form, but in service it undergoes changes and assumes a crystalline form, the degree of brittleness increasing until a fracture is not so much a matter of extra stress as of a disintegration of the metal composing the frame. This phenomenon is frequently observed in the case of light vehicles where an axle will sustain a heavy load for a prolonged period and eventually and unexpectedly will break under a lighter load. This is properly called fatigue of the metal. Even swords, once terrible in battle, when hung up long enough will fall to pieces of themselves.

Vanadium has changed all this, and in the increase of weight in locomotives it has admirably met the requirements of the service. It may also be stated that there have been important improvements in frame design. Construction has been altered to conform to the most correct engineering principles. Improved systems of frame bracing have been developed to meet the complex and heavy stresses to which locomotive frames are subjected. The accompanying illustration shows a recent sample of a vanadium cast steel main frame for a Mikado type locomotive for the Delaware, Lackawanna & Western Railroad Company. The casting is the product of the Union Steel Casting Company of Pittsburgh, Pa.



VANADIUM CAST STEEL MAIN FRAME FOR A MIKADO TYPE LOCOMOTIVE FOR THE DELAWARE, LACKAWANNA & WESTERN RAILROAD COMPANY.

How to Keep an Old Clock Going.

If any readers of RAILWAY AND LOCOMOTIVE ENGINEERING have a clock they value that seems to be near the end of its career of usefulness? Does it skip a beat now and then, and when it begins to strike seem to be in pain? Let me tell you what to do. Take a bit of cotton batting the size of a hen's egg, dip it in kerosene and place it on the floor of the clock and wait three or four days.

Your clock will be like a new one—skip no more, it will strike as of old, and as you look inside you will find the cotton batting black with dust. The fumes of the oil loosen the particles of dust, and they fall, thus cleaning the clock. Ye editor have tried it with success.

Cleaning Gauge Glasses.

Close the upper and lower valves and open the pet cock to empty the gauge glass of water. Hold a cup or other suitable receptacle containing muriatic acid of ordinary strength under the pet cock. Open the lower valve sufficiently to cause the acid to be drawn to the top of the glass. The alternate opening of the lower and upper valve causes the acid to be drawn up and expelled. Two or three applications will clean a dirty glass thoroughly.

Blackening Brass.

A black lacquer for brass is made of one part nitrate of tin to two parts of chlorine of gold. The article to be lacquered should be finely polished to begin with, then washed with the mixture. After fifteen minutes wash with water.

Mikado and Pacific Locomotives for the Duluth & Iron Range

Heavy freight traffic on the Duluth & Iron Range Railroad has heretofore been handled by Consolidation type locomotives using saturated steam. The most recent of these engines, as built by The Baldwin Locomotive Works, exert a tractive force of 42,600 pounds, and weigh in working order 198,850 pounds. The equipment includes slide valves, Walschaerts motion and a fire-brick arch. These locomotives handle 2,400 tons on a grade of 0.6 per cent.

The Duluth & Iron Range has recently received from the same builders four Mikado type locomotives which develop a tractive force of 56,000 pounds, or approximately 32 per cent. in excess of the Consolidation. They will haul over 3,000 tons on the grade above mentioned, and with higher steaming capacity in proportion to the tractive force developed, should make better time and have more reserve capacity for meeting adverse conditions when handling full tonnage.

These locomotives are fitted with the Seddon boiler feeding device, as developed by Mr. C. W. Seddon, Superintendent of Motive Power of the Duluth, Missabe & Northern Railway. The water is sprayed into the boiler near the front end, falling into a pan which is fitted tightly against the shell at each side. The front wall of the pan is lower than the back wall, so that the water overflows into the boiler at the greatest possible distance from the firebox. The pan is so sloped that all deposit accumulates in one corner, from which it can be easily removed through a suitable cleaning-hole. This device has proved most effective in preventing the deposit of scale on the boiler sheets and tubes.

The steam distribution is controlled by 15-inch piston valves, which are driven by Walschaerts motion. The Ragonnet power gear is applied, the mechanism being bolted to the boiler shell immediately in front of the firebox. Because of the wide furnace used in this design, it would be difficult to use a convenient arrangement of hand reverse lever. With the power-gear, however, this difficulty is avoided; as the mechanism in the cab occupies but little room, and can be conveniently located without crowding the other fittings.

These locomotives are fitted with an improved design of Hodges trailing-truck. The back equalizing beams are placed diagonally, so that they connect directly with the truck spring-links. The rear spring-links are pinned to a bracket, which is bolted to the engine frames. This plan dispenses with the cross-beams formerly used, and allows ample room for a large ash-pan.

MIKADO 2-8-2 TYPE LOCOMOTIVE FOR THE DULUTH & IRON RANGE RAILROAD.
B. R. Moore, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

PACIFIC 4-6-2 TYPE LOCOMOTIVE FOR THE DULUTH & IRON RANGE RAILROAD.

In addition to the locomotives described above, this road has also received, from the same builders, four passenger engines of the Pacific type. These exert a tractive force of 31,700 pounds, and while considerably lighter than the Mikados, are in many respects similar to them. The equipment includes a superheater, brick arch, Seddon boiler feeding device and improved Hodges trailing-truck. All wheels under the locomotive and tender are fitted with brakes.

Both the freight and passenger locomotives have Vanderbilt tenders. Those used with the freight engines are larger than the others, but the two designs are generally similar in construction.

Further particulars regarding these locomotives are given in the attached list of general dimensions:

Mikado type locomotives:

Gauge, 4 ft. 8½ ins.

Cylinders, 27 ins. x 30 ins.

Valves, piston, 15 ins. diam.

Boiler.—Type, wagon-top; diameter, 84 ins.; thickness of sheets, 13/16 in., ⅞ in., 15/16 in.; working pressure, 175 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 112 ins.; width, 96 ins.; depth, front, 88 ins.; depth, back, 75¾ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space.—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Material, steel; diameter, 5⅜ ins. and 2 ins.; thickness, 5⅜ in., No. 9 W. G., 2 ins., No. 11 W. G.; number, 5⅜ ins., 38; 2 in., 289; length, 19 ft. 5 ins.

Heating Surface.—Firebox, 252 sq. ft.; tubes, 3,959 sq. ft.; firebrick tubes, 37 sq. ft.; total, 4,248 sq. ft.; grate area, 74.6 sq. ft.

Driving Wheels.—Diameter, outside, 58 ins.; diameter, center, 51 ins.; journals, 10½ ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 30 ins.; journals, 6 ins. x 12 ins.; diameter, back, 42 ins.; journals, 8 ins. x 14 ins.

Wheel Base.—Driving, 15 ft. 9 ins.; rigid, 15 ft. 9 ins.; total engine, 33 ft. 8 ins.; total engine and tender, 68 ft. 10¾ ins.

Weight.—On driving wheels, 219,500 lbs.; on truck, front, 20,900 lbs.; on truck, back, 44,600 lbs.; total engine, 285,000 lbs.; total engine and tender, about 455,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 9,000 gals.; fuel capacity, 14 tons.; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 899 sq. ft.

Pacific type locomotives:

Gauge, 4 ft. 8½ ins.

Cylinders, 22 ins. x 28 ins.

Valves, piston, 14 ins. diam.

Boiler.—Type, wagon-top; diameter, 66 ins.; thickness of sheets, 11/16 in. and ¾ in.; working pressure, 190 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 96 ins.; width, 70¼ ins.; depth, front, 75¾ ins.; depth, back, 66 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, 5/16 in.; thickness of sheets, crown, ⅜ in.; thickness of tube, ½ in.

Water Space.—Front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

Tubes.—Material, steel; diameter, 5⅜ ins. and 2 ins.; thickness, 5⅜ ins., No. 9 W. G.; 2 ins., No. 11 W. G.; Number, 5⅜ ins., 24; 2 ins., 177; length, 19 ft. 9 ins.

Heating Surface.—Firebox, 176 sq. ft.; tubes, 2,487 sq. ft.; firebrick tubes, 26 sq. ft.; total, 2,689 sq. ft.; grate area, 46.8 sq. ft.

Driving Wheels.—Diameter, outside, 69 ins.; diameter, center, 62 ins.; journals, main, 10 ins. x 12 ins.; journals, others, 9 ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 33 ins.; journals, 6 ins. x 12 ins.; diameter, back, 42 ins.; journals, 8 x 14 ins.

Wheel Base.—Driving, 12 ft. 6 ins.; rigid, 12 ft. 6 ins.; total engine, 31 ft. 10 ins.; total engine and tender, 62 ft. 8⅞ ins.

Weight.—On driving wheels, 134,500 lbs.; on truck, front, 42,400 lbs.; on truck, back, 42,100 lbs.; total engine, 219,000 lbs.; total engine and tender, about 353,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7,000 gals.; fuel capacity, 12 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 561 sq. ft.

Regulating Traffic in Paris.

Paris is evidently weary of the chaos that prevails in its streets, for the new prefect of police has set himself to reorganize the traffic department and will name a standing committee at the prefecture to deal with all complaints. The famous cabs, too, so convenient for the pedestrian on the lookout for a lift, may be prohibited from crawling at a snail's pace through busy thoroughfares, on the watch for fares.

Paris is a charming city to foreigners as to natives, but it must be confessed that the traffic regulations fail to charm. Indeed, there can hardly be said to be any traffic regulation in Paris, and it is a much frayed jest that, after a street accident, the watchful policeman extricates the unfortunate foot passenger from the wheels and arrests him, allowing the driver to go scot-free. Except in the busiest hours, the Paris policeman feels himself quite superior to so mean a task as protecting pedestrians from the endless stream of passing vehicles, and contents himself with standing majestically aloof to watch the confusion.

Americans in Paris have been known to wonder what the policemen in the busy thoroughfares were paid for besides looking imposing. It begins to look as if they might be made as useful as the famous London "bobby," who is beloved of all honest travelers.—*Chicago Record-Herald.*

On Narrow Escapes.

Speaking of the narrow escapes that railway men encounter in following their calling, our chief related particulars of an experience that few people pass through and remain to tell the tale. He said:

"One time I was attached to a civil engineers corps which was locating a narrow gauge railway in Wisconsin. Part of the summer we were stationed at Marysville, a small village on the Rock river. Not far from the village in a solitary woodland, was a deep pool on the river where water lilies grew profusely. The chief engineer, Eugene Wiley, had his wife staying at the hotel. One day she mentioned in my hearing the wish to possess a bunch of the lilies on the Rock river, and I made up my mind to gratify her desire.

"A few evenings afterwards, I went to the pool, as they called the place, and found that all the lilies within easy wading reach had been gathered by the natives. All the good flowers were in deep water. Nothing discouraged, I took off my clothes and swam into the midst of the lilies and proceeded to tear off a good bunch, swimming about after the finest specimens. On concluding that I had all the flowers wanted, I began to swim ashore, when to my horror, I found that some of the long lily roots had wound themselves around one of my feet, forming a knot that held me fast. I was securely anchored in that deep pool. No boat was near and the chances for help were very remote.

"On realizing my position I was dreadfully panic stricken at first, and curiously enough remembered accounts my father had given me of several Sinclairs who had been drowned in the Caledonian Canal, and his injunction 'avoid the water laddie and ye'll no be drowned.'

"After a few minutes of panic and violent tearing of the weeds, I managed to calm myself sufficiently, to consider what means there were for escape. I made several attempts to reach the knot that bound my foot, which ended in the swallowing of water. Then a plan came to my mind. I swam quietly for a few minutes to regain breadth, filled my lungs with air, then pulled myself to the bottom where I sat and with both hands untied the knot that was holding me. It took only a few seconds, but it seemed half a life time. When I got back to the surface of the water free, I permitted myself to float on my back long enough to regain strength, then I swam about and collected the flowers which had floated away.

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Railway Organizations.

We have heard comments made of late by general railway officers, to the effect that there are getting to be too many organizations composed of minor railway officials; but it would be difficult to point out one association of the kind which fails to promote railway interests, and have the work they supervise done better and at lower cost. The forming of associations by men engaged in the same line of business may be due principally to that social instinct that draws people together who possess knowledge in common, but the spread of knowledge that results is particularly beneficial not only to the active workers but also to the employers.

The forming of associations composed of men engaged in the same line of business is peculiarly an American trait, such a thing being unknown in foreign countries except in the line of labor unions. From the American Railway Association to the Railway Tool Foremen's Association carries us through a long list, and every one of the organizations is doing useful work that is given freely without compensation. Attending conventions may take useful men out of the shop a few days annually, but those left in charge are stimulated to do their best as substitutes. Not only does the work progress as well as when the veterans were in charge, but it results in the training of other men to fill responsible positions. Another circumstance that deserves attention is the good will spread around, and the growth of loyalty that proceeds from men cherishing the feeling that they are used as generously as circumstances will permit. The fine old injunction "let us reason together," really means, "let us engage in exchange of sentiments," and that is what all the railway organizations are striving to do. May their success keep growing in magnitude.

Mechanical Stokers.

The subject of mechanical stokers has been under investigation by the American Railway Master Mechanics' Association since 1905, and has been discussed more or less at every convention since that time. Locomotives have been increasing in power every year until the question of firing the huge boilers to maintain the required pressure of steam had become too great for human muscle and endurance. We have found in the development of the arts that the device needed to lighten or form a substitute for manual labor has come when the world could no longer get along without it and we concluded that the same law would hold good with locomotive mechanical stokers that triumphed with the development of the steam engine and many other mechanical triumphs.

The report on Mechanical Stokers submitted to the last convention of the Master Mechanics' Association is so positive concerning the progress made during recent years that no uncertainty now exists concerning the success of the device that is destined ultimately to make the locomotive fireman's duties turn more on skillful attention than on physical power and endurance. Says this admirable report: "The utilization of machinery to perform what hitherto was accomplished by manual labor has been achieved in much larger as well as smaller problems, but few have been more welcomed than the automatic or semi-automatic apparatus by which the larger locomotive is supplied with fuel at a rate and in such manner as to produce efficiency in the operation of the locomotive with a reduction of physical work on the part of the fireman."

Since the first mechanical stoker was applied on the Cleveland, Columbus, Cincinnati and St. Louis Railway by Mr. W. Garstang, then superintendent of motive power, numerous experiments have been made in the line of attempted improvement and many novel forms of apparatus have been tried, most of them to end in failure. There now remain eleven forms of stoker, buoyed most of them by hope, viz.: Strouse, Barnum, Hayden, Brewster, Harvey, Dickinson, Erie, Hanna, Gee, Crawford and Street. The two last named stokers are successful and the number in operation has justified the investigators that the mechanical stoker is no longer an experiment. The successful stokers represent two types, the Crawford, which is underfed and the Street, which is fired from above and is spoken of as the scatter type. Both these forms of stoker work very successfully and both have their friends who regard their favorite as the mechanical stoker of the future, but time and experience are required to settle that question.

When mechanical stokers first began to appear it was reported that the firemen displayed antipathy to their use, but that sentiment has now changed and those most interested in the success of the stokers say that firemen as a rule have worked with zeal and intelligence to make the stoker work successfully. It is admitted by many expert firemen who have had years of experience with hand firing, that they have derived valuable information in hand-firing after handling the stoker and closely watching its operation.

From the information that came to the committee, there was some conflict of opinion concerning the fuel economy that resulted from using the mechanical stoker, but the evidence indicated quite positively that locomotives equipped with the stoker were capable of hauling heavier trains than those that were hand-fired. Another important fact brought out was that a stoker can use successfully very inferior grades of fuel, fuel that would be useless when hand-fired.

The relation of the stoker installation to the amount of tonnage handled, as against hand-firing, was sought, and in reply to this query, roads using the stoker have expressed themselves as follows:

The Carolina, Clinchfield & Ohio Ry. reports heavier trains hauled, but does not say to what extent.

The Vandalia R. R. reports their stoker-fired engines consume about the same time on the division, but that a more uniform steam pressure is maintained.

The B. & O. R. R. reports that it is possible to haul heavier trains with the stoker engines.

The Pennsylvania Lines West of Pittsburgh report 15 per cent. more tonnage hauled with stoker-fired engines on slow freight and on long, heavy grades.

The Buffalo, Rochester & Pittsburgh have not observed any difference between hand-firing and stoker operation.

The St. Louis & San Francisco R. R. reports better performance with stoker-fired engines, stating that some firemen are not able to keep up steam on heavy trains on the long runs.

The Norfolk & Western Ry. has not recognized any difference in tonnage rating between hand-fired and stoker-fired engines, since with but one exception all of their stokers are applied to one type of locomotive. It has been observed, however, that with the stoker operated properly the locomotive can be worked to its maximum capacity without any marked effect upon the steam pressure, which is a distinct advantage.

The Virginian Railway report has some improvement in steaming capacity and tonnage hauled, but do not give amounts.

Shop Foremen's Convention.

The International Railway Shop Foremen's Association, with which nothing is wrong except the length of the name, held its Ninth Annual Convention last month and it was not only the most successful convention held by the shop foremen, but it was one of the finest meetings ever held by railway mechanical officials. There is a good old saying which advises the shoemaker to keep to his last, and is directly applicable to every line of human endeavor in advising people to attend to their own business. The work done by the Shop Foremen's Association was notable for its devotion to shop matters instead of to general engineering matters. The reports of committees were all printed in advance so the men in attendance had ample time to study the subjects in detail. This naturally brought out very full discussions.

The first subject discussed was Superheated Locomotives. Most of the mechanical organizations which have discussed this subject have devoted much attention to describing the principles of superheating, which readily leads into incomprehensible argument. The shop foremen had little or nothing to say about principles, they occupied themselves in telling how superheating apparatus could best be kept in good working order and how defects could be remedied. Considerable attention was given to the difficulties of supplying proper lubrication and valuable information was given as to how lubricators can be kept in good working order. We feel certain that men running locomotives equipped with superheaters and workmen who have to maintain that form of mechanism will receive useful hints from careful study of this report and the discussion thereon.

"Engine House Efficiency" discussed at considerable length the causes of locomotive failures and made valuable suggestions of how the defects that lead to failure might be overcome. The text of the report reads: "The business of a railroad is the sale of ton miles. Hence the motive power is like cash in hand. Everything, then, that helps towards the effectiveness of the locomotives means increase earnings for the company. Efficient locomotive performance, however, is largely determined by the engine house. Therefore an efficient engine house will give a correspondingly good engine performance. By engine house efficiency is meant the handling and repairing of power to give the highest grade locomotive performance that can be brought about by reasonable costs and minimum time of detention." The entire subject of engine house efficiency was admirably treated from that standpoint.

The remaining subjects reported upon and discussed were: Shop Schedules; Driving Boxes; Driving Box Work, which was the subject of two papers; and Report of Committee on Apprentices. Each and every one of these reports would have been a credit to any railroad mechanical organization and we can only finish by congratulating the International Railway General Foremen's Association on the admirable work performed by their Ninth Annual Convention. Praise is also due to President Pickard for the excellent manner in which he handled the meetings, making every minute of each session count for performance.

Commissioner Chase.

In appointing a locomotive engineer to membership on a New York State Public Service Commission Governor Sulzer has drawn a howl, or a whine rather, from some quarters. This is not to be wondered at. There are quite a number of creatures in the world with the outward semblance of men and who were kept at school till their hair was nearly gray, in the vain hope that they might fill a place or do a little of the world's work. When such parasites see another man who had no such early advantages rise by sheer force of merit to a high place in popular esteem, and is called to fill some office, then a spirit of envy, malice and all uncharitableness seizes upon the fossilized barnacles, who, if they have grown at all, have, like the cow's tail, grown downwards.

Of Mr. Chase, the locomotive engineer who has received the appointment, we know, of our own knowledge, little or nothing. We do know, however, that such appointments as he has received are not raffled for. We also know that running a locomotive does not preclude the possibility of an intelligent man taking an interest in public affairs. Several United States Senators were locomotive engineers at one time. Railroad presidents of our acquaintance were at one time brakemen. Give Mr. Chase a chance. Men reap largely as they sow. It will be time to condemn him when he is found incompetent. As Kipling says: "Creation's cry goes up on high from age to cheated age; send us the men who do the work for which they draw the wage."

Centenary of the Locomotive.

The American people are very much given to celebrating the memory of events considered important in the world's history, but there is one event supreme in the development of civilization which seems to be ignored—that is, the invention of the locomotive engine, the proper year for such a celebration being 1913, as the first locomotive to do regular train hauling was put to work in 1813.

The inventor of the locomotive engine, whose successful operation first imparted vitality to railway enterprise, can scarcely be said to belong to one nation, certainly not to one man. The elements which made the locomotive a successful machine have been devised and applied by a great many different inventors and mechanics. The idea of applying steam to the propulsion of land carriages was discussed in dilettante fashion by the philosophers who flourished so vaingloriously towards the end of the French monarchy. Some small fruit came from much wordy seed, for about the year 1770 an officer of the French army, named Nicholas Joseph Cugnot, built a steam carriage intended for military purposes. The engine used high pressure steam and had two cylinders receiving steam from a small boiler about the size of a kitchen chaldron. The machine worked and moved about three miles an hour. His invention was the first automobile. The apparatus is preserved in a Paris museum.

Following details of attempts to construct a land transportation steam engine we find that in 1784 William Murdock, an assistant to Boulton & Watt, the engine builders, made a working model of a road engine and ran it about the country roads in England. The development of the high pressure, high-speed engine, was largely due to the labors of Oliver Evans, the well-known American inventor. In 1804 Evans built a dredging scow weighing about two tons which he mounted on wheels and propelled through the streets of Philadelphia by the power of its own steam engine. While many crude attempts were made from Cugnot's time on to apply steam propulsion to road vehicles, the first attempt to put into operation a steam-driven vehicle which was designed to run on rails was made by Richard Trevithick in 1803. An engine was constructed to do work in this line and it pulled some cars, but was too complex for regular work and was abandoned after a few trials.

For the next ten years after Trevithick's experiment there was considerable effort made to produce a locomotive that would work satisfactorily. Trevithick's engine was exceedingly slip-

pery, due to the power being too great for the weight available for adhesion. This led to inventions intended to prevent the slipping of the driving wheels, and much ingenious labor was wasted in overcoming this imaginary defect.

One locomotive was built to propel itself by levers that acted to imitate the action of a horse's hind feet. Several locomotives were built which operated a cog wheel that engaged in a rack rail. Some of these were kept at work for years.

There was in the employ of Christopher Blackett, principal owner of the Wylam colliery in the north of England, two workmen much above the common mechanics, who took a keen interest in mechanical traction. One was William Hedley, superintendent (viewer was his title), a man who studied scientific problems, and Timothy Hackworth, foreman blacksmith. Hedley superintended a series of experiments to prove the extent of traction of wheels turning on a smooth rail, and found that the ordinary weight carried by a locomotive would prevent slipping. He then designed a locomotive which was built by Hackworth in the blacksmith shop. That engine was put to work in 1812 and hauled coal cars as far as its capacity went, but it proved deficient in boiler. This was remedied in a second engine which Hedley had constructed in 1813. That locomotive was called the "Puffing Billy," and is now preserved in the South Kensington Museum in London.

The "Puffing Billy" was the beginning of a grasshopper type of locomotive which, under a variety of modifications, became largely used until in 1829 the directors of the Liverpool & Manchester Railway offered a prize of £500 for a locomotive which would meet certain requirements. The "Rocket," built by Robert Stephenson, won that prize and introduced a new form of locomotive, whose principal novelty was a multi-tubular boiler and cylinders set at an angle, connecting with a single pair of driving wheels.

The success of the "Rocket" turned the attention of locomotive designers to the simplified form of engine, but before that time hundreds of grasshopper locomotives were at work, the coal hauling connected with most collieries having been done by engines of that character, so it is fair to say that Hedley's locomotive led to the introduction of steam power upon railways. George Stephenson, who was superintendent of a large colliery, copied one of Hedley's locomotives and began building similar engines, but they never proved so successful as those turned out by Hedley.

George Stephenson became chief engineer of the Stockton & Darlington Railway, the first line opened for general traffic, which gave him prominence in the railway world and afterwards led to his appointment to a similar position on the Liverpool & Manchester Railway, now a part of the London & Northwestern Railway system. He was a strong-minded positive man and a warm advocate of locomotives, at a time when such engines were far from being popular. On that account he came to be called the Father of the Locomotive, although he never invented a single thing that became a permanent attachment to the locomotive. The 'Rocket" engine, for whose construction he receives much credit, was built by his son, Robert, the most important improvement, the multi-tubular boiler, having been the invention of Secretary Booth, of the Liverpool & Manchester Railway Company.

To Great Britain belongs the honor of having invented the first locomotive to operate railway trains; but the North American continent supplied the lines on which that form of steam engine achieved its greatest triumphs, not only mechanically, but in the interests of civilization.

The need for improved means of land transport was pressing upon public men in the United States as early as it was among the people of Great Britain, and construction of railroads was begun on this side of the Atlantic about the time that lines for general traffic were opened in England. Through the construction of railroads a vast wilderness on the American continent has been changed from gloomy, untrodden forests, dismal swamps and pathless prairies into the abode of high civilization. The invention of the locomotive engine brought about this magnificent change, so it seems highly commendable that the people of North America should join in a great celebration of the Centenary of the Locomotive.

Superheated Steam.

The most important improvement effected upon the steam engine since inventors ceased to use the steam cylinder as a condenser has been the designing of the necessary apparatus for providing the working cylinders with superheated steam. Many years have passed since steam engineers perceived the economical advantages that would result from the use of superheated steam; but the difficulties in effecting the desired improvement lay principally in the complications involved in adding heat to the saturated steam that had been evaporated in the boiler.

After much ingenious labor had been devoted to solving the complex engineering problem, stationary engines and marine engines were provided with superheated steam resulting in wonderful economy of fuel, a fact soon acknowledged by all steam engineers who understood their business. Then came the turn of locomotives which today is undergoing the pains of solution. Not that there is doubt about the economical results secured. The main difficulties present the question, what mechanism can be provided that will control superheated steam without making the improvement cost more than it is worth? As knowledge concerning the character of and action of superheated steam extends among those responsible for keeping the mechanism controlling that form of steam in proper order we will hear less of criticism of its action. The attention devoted to superheated steam during the last year by railway mechanical associations assures us that the necessary education is getting rapidly spread among the ranks where it will do the most good, and it seems certain that in a very few years all details of superheater locomotive construction, repair and operation will be as thoroughly understood as the same particulars concerning the ordinary saturated steam locomotive.

In the various discussions of superheat locomotives, we notice that not a few of the men taking part have very imperfect knowledge of superheat and its action. As long ago as the time of James Watt, steam engineers discovered that the steam cylinders acted to some extent as condensers of steam entering their parts and then as re-evaporators for the steam passing into the exhaust. Saturated steam as it exists in the boiler is always on what has been known as the "dew point," that is, it is always ready to drop back into water when it is subjected to the least loss of heat. As the metal of the steam chests and cylinders is always colder than the steam in the boiler, condensation ensues as soon as the steam touches the cooler substance. Condensation means sending the steam back into water and water has no expanding force, the force that produces mechanical work. So all the steam thus condensed loses its vitality and the heat used in evaporating it is wasted. The hot water thus spreading itself within the cylinder has a most pernicious effect in carrying away heat.

Experimenters found that the loss from the condensation of steam in the cylinders varied from 20 to 40 per cent., according to the cooled condition of the cylinders. Superheating the steam before it reached the cylinders would prevent that loss, because superheated steam could endure some loss of heat without turning into water, but it also would tend to prevent condensation of saturated steam.

The locomotive engine was found to be peculiarly addicted to losing heat from cylinder condensation owing to the exposed position of the steam chest and cylinders. As a partial preventive of this evil European locomotive builders adopted the practice of using inside cylinders which are partially protected by the heat in the smoke box. This involved using a cranked driving axle which the designers considered the least of two

evils, a practice which has never found favor with American engineers.

Many years ago D. Kinnear Clark, the celebrated Scottish engineer, carried out a most exhaustive series of tests of locomotives, particularly concerning their economical operation. In connection with these tests Mr. Clark expressed a famous aphorism to the effect that "expansive working is expensive working." He found that working the steam expansion led to so much cylinder condensation that more waste of steam resulted than was due to more protracted cut-off. Numerous resorts were adopted to try and prevent the heavy losses due to cylinder condensation, cylinder jacketing being for a time a favorite experiment, but all came to naught until the practice of superheating was introduced. There are difficulties connected with maintaining the mechanism necessary to control superheating, but these difficulties are no greater than those previously encountered in the improving of the locomotive engine, and we feel certain that success will be achieved by the numerous engineers engaged in solving the problem.

Watch and Learn.

This is an excellent motto for every young man to adopt, and, by a close observance of it, it will prove of great value, even after he becomes grown up and starts out in business for himself. There is no surer way of gaining knowledge than by a careful and understanding watchfulness of others in the same line of business as yourself. As an apprentice, you cannot expect to know everything, and the best way to gain information from others is to show a willingness to learn; then they will take an interest in teaching. But if, as is too often the case, a young man, after he has been a few months in a place, pretends to know as much, and sometimes more, than those much older and more experienced than himself, he will not get much information from his fellow workmen; neither will he retain their good will for any length of time, and may expect to have all manner of practical jokes played upon him. As a journeyman, if you are intelligent, you will very often have occasion to believe that you do not know it all, and, in fact, the longer you live and the more you learn, the more you will find that there is to be learned. The egotistical and loud man is seldom a perfect man, and is generally very far from being as near perfection as he would have others think him. The person who, on a first acquaintance ,is anxious to tell you what he knows, and is very free in giving advice and information without the asking, generally exhausts the supply before very long. He who is willing to listen is generally the one whose source of information is broader and of a more durable, valuable and substantial kind.

An example may prove the idea to be conveyed more clearly. An employer was in want of a good, practical and experienced man for a certain class of work. A young man applied for the position, who was very certain that he "knew all about the machine," and he was engaged. It was not long before every man in the shop knew all that he did, and one very valuable thing that he did not, and that was that he did not know all that he pretended to. His manner and braggadacio very soon got most of the men down on him. They were not disappointed. The new machine arrived, and was set up ready for operation. The young man was given a job to be worked off, and began operations with that self-conscious air of superiority that is generally apparent in characters of this description. One whole day he worked on the job, and it was not then in a condition to be run. Not only that, but he had shown the men, who of course were secretly watching him, that he knew practically nothing of the machine. Then he began to lay the blame for the trouble upon others, and asked assistance and "points" from some of the other workmen. This of course he did not get, and finally another young man was put on the job, and the pretender was discharged amid the taunts and ridicule of the others.

If the young man had shown good sense when he first came into the shop; not been quite so free to tell all he knew, and had shown a willingness to learn, there was not a man in the place that would not have gladly assisted him, and he might have remained in a good position. It sometimes pays to be ignorant, at least a little modesty is a good thing to take with you on going to a new place. If you know more than you pretend, it will soon be found out, and you will be the gainer; but, if you fail to make good your pretensions, not only your employer, but all your fellow workmen will be "down on you," and things will be correspondingly unpleasant.

Origin of Mile Posts.

Mile posts are installed on the right of way of all railways, but on the American continent there is no law requiring the installation of mile posts, but in Europe it is different. In the British Isles mile posts are located one-quarter mile apart. In the early railway days there was much uncertainty concerning the distance between towns by rail, as the railways did not follow on the same lines as the statute roads followed, consequently there were numerous disputes about the proper charge for the transportation of freight. This led to the passing of an Act of Parliament which required all railways to establish mile posts every ¼ mile and to publish fare tables indicating the rates.

Railways for Alaska.

If any European country had control of Alaska with its magnificent resources and opportunities for settlement of farmers and the establishing of comfortable homes, it would be teeming with an industrious and prosperous population. The United States being possessed of overabundance of land pays too little attention to its insular possessions.

Franklin K. Lane, Secretary of the Interior, is on a visit to Alaska and he holds sound views about that territory. He is reported to have recently said:

"Alaska should be aided to open up her immense resources. The first step should be a Government-owned railroad to the seaboard from the coal fields. Let Congress appropriate money for the first Alaskan railroad and there would be, in the next two years, a colonization movement to the northern territory which would far exceed the rush to Government lands within the nation proper.

"Alaska has 65,000,000 acres of land where the grass grows waist high in the Summer. It is tillable soil. Thousands of reindeer feed on the moss-growing ranges, and there is no reason why, with proper transportation facilities, Alaska should not supply the nation with reindeer meat, which is more tasty and nourishing than beef."

Secretary Lane said he would advocate a Government coaling station in an Alaskan land-locked harbor, where the Pacific Fleet could be provisioned for a world cruise.

Difficulties of Arbitration.

Considerable ill-natured criticism has been poured upon the management of the Erie Railroad because they withdrew from the combination of managers trying to arbitrate the demands of trainmen for increase of pay and shorter hours. The law under which arbitration is sought provides that no award by the arbitrators should bind any individual to labor against his will. It is a poor rule that fails to work both ways. To provide that labor should be permitted to repudiate the award of arbitrators without penalty while holding the employer responsible appears to be manifestly unfair.

On the whole, however, the negotiations for settlement of the claims of different classes of railroad men have been maintained with fairness on both sides, and a fair settlement with the train men and conductors seems now to be certain. There was some difficulty in carrying out arbitration under the Erdman act which has been widened by the Newlands amendment, which increases the personnel of the Board of Arbitration. Some difficulties in adjusting the decision given to the firemen has been experienced, but as we go to press the prospects for harmonious settlement are good.

Pacific Type of Locomotive for the Lackawanna

With a view of bettering operating conditions, and reducing operating costs, the Delaware, Lackawanna and Western Railroad has introduced several very powerful locomotives of most approved design into their passenger and freight traffic. In June, 1912, the American Locomotive Company delivered to the railroad company fifteen Mikado type freight locomotives, having a total weight of 312,000 pounds, and a tractive effort of 57,100 pounds, and seven Pacific type passenger locomotives having a total weight of 284,000 pounds and a tractive effort of 40,800 pounds.

These engines have so thoroughly demonstrated the fact that the most powerful locomotives of approved design are also the most economical, that not only have the Mikados and Pacific passenger engines been duplicated, but seven of the most powerful Pacific type locomotives ever built by the American Locomotive Company have recently been introduced into the fast freight service. They have a total weight of 286,000 pounds and a tractive effort of 43,100 pounds, combined with a large and well proportioned boiler, are making an excellent record in this class of service, in which speed and hauling capacity are equally governing factors. Previous to the introduction of these large engines, the fast freight traffic was handled by locomotives of the Mogul type. The Moguls have a total weight, engine and tender, of 303,700 pounds, a tractive effort of 29,480 pounds, and a total heating surface of 2,185 square feet. The new Pacific type engines have a total weight, engine and tender, of 455,600 pounds, a tractive effort of 43,100 pounds, and a total equivalent heating surface (evaporating heating surface plus 1½ times the superheating surface) of 5,292 square feet. As compared with the Mogul type, we have an increase in weight of 50.0 per cent., an increase in power of 47.8 per cent., with an increase in equivalent heating surface of 142.0 per cent.

In test runs comparisons were carefully made and on a train mile basis the big new engines handle their increased train loads on practically the same coal and water consumption as the smaller Moguls, while the amount of coal per 1,000 ton miles showed a gain in favor of the Pacifics of about 27 per cent., while the water consumption showed 23 per cent. in favor of the Pacifics.

Interesting features that have been included in this design are: Schmidt superheater, firebrick arch, pneumatic firedoor, screw reverse gear, extended piston rods, self-centering valve stem guide, long main driving box, Woodard engine truck, improved outside bearing trailing truck, builder's latest style of throttle lever support, and a specially designed draft gear on the engine front end.

Engine decks are provided with special grate shaker brackets which are completely enclosed against the dropping of coal. This permits the use of the standard tender apron without the necessity of covering the usual openings for the grate shaker brackets.

Tenders are equipped with low type, quick opening tank well, operating from the ground, and located outside of channels. This keeps the top of the tender free from stuffing boxes or operating levers. This valve is designed so that during periods of standing the valve can be closed and the water in the hose blown back into the tank, thus leaving the hose free from freezing.

The following are the general dimensions of the new Pacifics:

Track gauge, 4 ft. 8½ ins.

Fuel.—Bitum. coal.

Cylinders.—Type, Simple piston; diam. 25 ins.; stroke 28 ins.

Tractive power, simple 43,100.

Factor of adhesion, simple 4.33.

Wheel Base.—Driving, 13 ft.; rigid, 13 ft.; total, 33 ft. 10 ins.; total, engine and tender, 66 ft. 4 ins.

Weight.—In working order, 286,000 lbs.; on drivers, 186,500 lbs.; on trailers, 50,500 lbs.; on engine truck, 49,000 lbs.; engine and tender, 455,600 lbs.

Boiler.—Type, extended wagon top; O. D. first ring, 78 ins.; working pressure, 200 lbs.

Firebox.—Type, wide; length, 111⅛ ins.; width, 75¼ ins.; thickness of crown, ⅜ in.; tube, 9/16 in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 6 ins.; sides, 5 ins.; back, 5 ins.; depth (top of grate to center of lowest tube), 21½ ins.

Crown staying, radial.

Tubes.—Material, charcoal iron; number, 265; diam. 2 ins.

Flues.—Material, seamless steel; number, 36; diam., 5⅜ ins.

Thickness Tubes.—No. 11 B. W. G.; flues, No. 9 B. W. G.

Tube, Length.—20 ft.

Heating Surface.—Tubes and flues, 3,768.9 sq. ft.; firebox, 199 sq. ft.; arch tubes, 21.6 sq. ft.; total, 3,989.5 sq. ft.

Superheating Surface.—867.8 sq. ft.

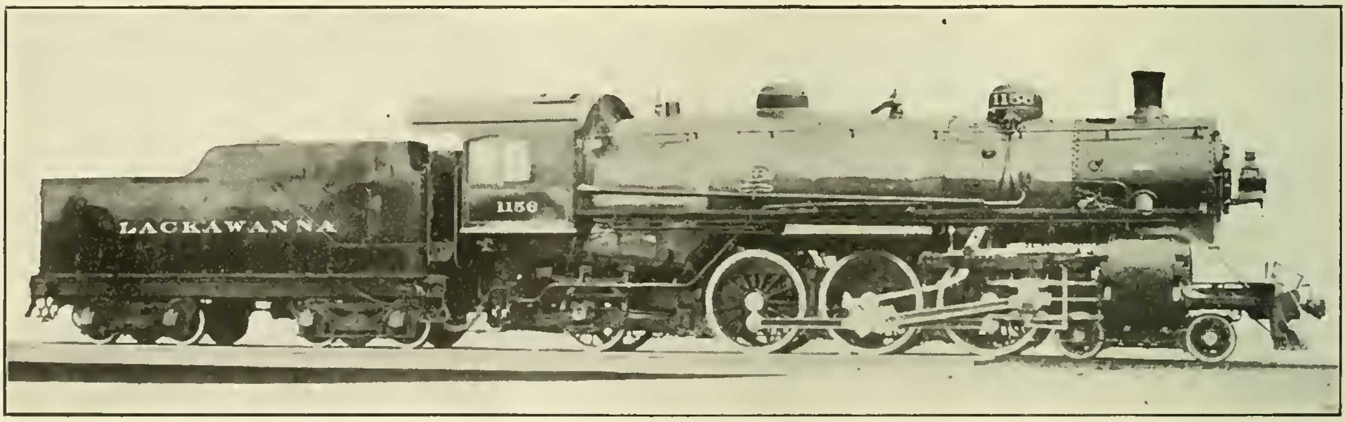
Wheels.—Driving diameter outside tire, 69 ins.; center diam., 62 ins.; driving material, main and others, C. steel; engine truck, diam., 30 ins., kind, National No. 3; trailing truck, diam., 50 ins., kind, C. S. spoke; tender truck, diam., 36 ins., kind, forged steel.

Axles.—Driving journals main, 11 x 21 ins., other, 10½ x 13 ins.; engine truck journals, 6½ x 12 ins.; trailing truck journals, 9 x 14 ins.; tender truck journals, 6 x 11 ins.

Driving Boxes.—Main and others, C. steel.

Brake.—Driver, Amer. W. M. 3, West. E. T. 6; truck, Amer. W. D., West. D.; tender, West. E. T. 6; air signal, West. L. 1—22½ x 72 ins.; pump, 2—11 ins.; reservoir, 1—22½ x 96 ins.

Tank.—Style, water bottom; capacity, 9,000 gallons; capacity fuel, 10 tons.



PACIFIC 4-6-2 TYPE LOCOMOTIVE FOR THE DELAWARE, LACKAWANNA & WESTERN RAILROAD.
H. C. Manchester, Superintendent of Motive Power. American Locomotive Company, Builders.

Questions Answered

TRACTIVE POWER AND TONNAGE RATING.

J. F. H., E. Macon, Ga., writes: (1) In figuring out the tractive power of several locomotives described and illustrated in Railway and Locomotive Engineering that are equipped with superheaters, I am in error about 1,000 pounds, by taking the rule of allowing 85 per cent. of boiler pressure. Are engines equipped with superheaters calculated in the same manner in regard to their tractive power as engines using saturated steam? (2) What is the proper tonnage for an engine rated at 23,400 pounds tractive power where the leading grade is 1½ per cent. and 1¼ per cent. with four degree curves? (3) Is it good policy to rate an engine to haul every ton it is capable of moving or allow for low steam and bad rails? A. (1) It is the general practice to calculate the tractive force of a superheater locomotive in the same manner as that of an engine using saturated steam. In the case of large engines developing high tractive force the variation referred to is relatively so small that in figuring tonnage rating, the difference may be considered negligible. (2) A locomotive working on a grade of 1½ per cent. would require a tractive power of at least 35 pounds per ton which, with the rated power given, would be equal to about 670 tons, including the weight of the engine and tender. (3) It is not good practice to load engines with the absolute maximum that they can haul. The best plan is to adjust the rating so that the summit of the ruling grade will be passed at a speed of about 10 miles per hour, as this will allow some margin for unfavorable conditions. It is impossible to make an absolute rule that will suit all cases, as there are many varying conditions that affect train operation and which must be considered when establishing a tonnage rating.

BROKEN CROSSHEAD.

P. M., Conneaut, Ohio, asks: In case of a broken crosshead, broken at the keyway of the piston and the piston removed, with front cylinder head knocked out, is it necessary to take down the main rod? Would there be any danger of there being too much weight on the guide bars? A. If there was no damage done to the main rod or its connections there would be no occasion for its removal. In the absence of the piston there would be less weight on the guide bars. It may be added that if the locomotive was to be moved by its own steam applied through the undamaged engine it would be necessary to block the slide valve on the damaged side in the center of the valve seat and remove the valve rod.

ICE, SNOW AND MOISTURE.

W. L. B., Bonavista, Newfoundland, writes: (1) In solidifying water by freezing, its specific gravity is .916. When liquefied again it will weigh the same as it did before it became solid. What is the scientific explanation? (2) Snow and moisture on the rails nearest the joints are the last to melt. What causes this? A.—(1) The simple, scientific explanation is that no part of the segregation of gaseous molecules has been allowed to escape on account of the natural cohesion of particles composing the combination of gases known as water. Evaporation can take place only if the body of water or mass of ice is exposed to the atmosphere at a higher temperature. It may be added that water heated until it assumes the form of steam expands in volume 1,644 times at atmospheric pressure, and if the pressure is increased many times and the steam allowed to raise a piston, it will still retain its original weight either in the form of steam, water or ice. (2) The rigidity of the rail joint has the effect of making the mass of metal in the vicinity of the joint less liable to vibration. An increased degree of vibration has the double effect of loosening adhesive particles as well as slightly raising the temperature by the frictional resistance of the atmosphere.

ECCENTRICS, THROTTLES AND BOILERS.

W. D., Jersey City, N. J., writes: Will you kindly answer the following questions? (1) What is meant by the throw of the eccentric? (2) What is the common cause of a throttle sticking? (3) What State in the American Union lives up to the standard of building boilers? A. (1) The throw of the eccentric refers to the amount of variation in the smaller and larger parts of the eccentrics. Supposing that the larger part of the eccentric, that is, the point extending furthest from the center of the axle, is 2½ inches further from the center of the axle than the smaller part of the eccentric, the throw of such eccentric would be 5 inches. (2) There are a number of causes that have occasioned the sticking or hindering of a throttle valve from opening. Among these are the tendency of the throttle rod gland to cut into the throttle rod raising a slight shoulder on the rod. The rod packing may be too tight. Throttle rods having offsets may become distorted and collide with staybolts or rivet heads or a part of the boiler, especially wagon-top boilers. Then the bell crank connection at the throttle valve may become disconnected. And lastly, the edges of the throttle valve bearings may become glued with oil or sediment after a prolonged lack of movement. (3) All the boiler constructors in all of the States build boilers according to specifications and the boilers are inspected and tested before going into service.

BROKEN ROD STRAPS AND KEYS.

J. D. W., Brunswick, Ga.: We have two 8-wheel passenger engines here, one with what is known as female coupling, and the other with male coupling at the front end of main rod. The female coupling has repeatedly broken the front end rod key, while the male coupling has also broken the front end strap or piston. Can you suggest what the cause is? A. If the main rods are properly adjusted, that is by having the front end keyed up as snugly as possible without actually binding, and the back end of the end of the main fitted and keyed so that it revolves without lost motion, a shock sufficiently strong to break a strap or key must arise from some organic defect in the piston, or from defective or insufficient lubrication of the piston.

STUCK PISTON RINGS.

N. J. B., Lakeland, Mich., writes: What causes packing rings to stick fast in the grooves in the air pistons of the 9½ and 11-inch air pumps; is it entirely due to improper fitting? A.—It may be due to one of several causes, if a standard width of ring is used in a standard width of groove and not overlapped at the ends, the sticking is not due to the manner in which they are fitted. The way rings are usually stuck in the grooves is by the piston striking some obstruction, such as a piece of broken air valve in the cylinder or by water running down the rod into the air cylinder during the time an engine is in the shop, or the pump not in use for several days, sometime corrodes the rings in the piston grooves and when the pump is again started they remain stuck.

PRESSURE IN PIPES.

K. N., Wheeling, W. Va., writes: What pressure is in the air pipes of the E. T. equipment if the pump is started with the brake valve handle in lap position? A.—When the governor then stops the pump, you will have main reservoir pressure in the reservoir pipe, the branches to the feed valve and reducing valve, and to the rotary valve of the automatic brake valve, in the distributing valve supply pipe, in the red hand gage pipe, in the maximum governor pipe and in the pipe leading to the dead engine check valve. In the feed valve pipe and the excess pressure pipe you will have brake pipe pressure. The reducing valve pipe and the signal pipes will contain signal pipe pressure, while the remainder of the pipes of the equipment will contain atmospheric pressure.

Catechism of Railroad Operation

Questions and Answers.
Second Series.

(*Continued from page 243.*)

Q. 58. (a) With the Walschaerts and Young valve motion explain how you would disconnect for a broken eccentric, eccentric rod, link, trunnion pin or link foot?

(b) Radius rod, radius rod hanger, lifting arm, reversing arm or reach rod?

(c) Broken main rod, crosshead, crank-pin, bent or broken piston or knocked out cylinder head?

(d) Broken crosshead arm, lap and lead lever, or lap and lead connector?

Ans. (a) Remove the broken parts and block the link, block in the middle of the link, disconnect the radius rod hanger. With the back end of the radius rod blocked in this manner the valve will travel each side of the center the amount of lap and lead thereby giving us the amount of lead opening. In this manner the cylinder can be lubricated from the lubricator.

(b) In the event of a broken radius rod hanger or lifting arm would place blocks in the top and bottom of link backing in forward motion at such point of cut-off that would enable the engine to handle the train. For broken reversing arm or reach rod or reverse lever would place blocks in links, blocking at such point of cut-off as will permit handling train. It is the opinion of many mechanical men, however, that blocking in one link is sufficient. Still another method is to place a bar across the frame under the lifting arms and secure it, holding the links up in this manner. For broken radius rod remove the broken parts if necessary, clamp the valve in mid-position and take down the union link and tie the lower end of the lap and lead lever to the back cylinder cock.

(c) When main rod breaks remove the broken parts and block crosshead in back end of guides making sure that pin on front wheel will clear, disconnect the front end of radius rod from lap and lead lever and suspend it to the running board by means of a chain or wire, clamp the valve in mid-position. If it is necessary to run the engine some distance at any high rate of speed the link block can be blocked in the middle of the link when there will be no motion imparted to the radius rod. If crosshead breaks in such a manner that it will not carry the front end of the main rod the main rod must be taken down and blocked the same as for broken main rod. A collar should be placed on the main pin in order to hold side rods in place. In this case the crossheads should also be blocked if there is a sufficient amount of it left, if not the piston rod may be blocked forward. In the event of a main pin breaking the eccentric on that side main rod and all side rods on that side and all side rods on opposite side must be taken down, the crosshead blocked in the back end of the guides, radius rod disconnected from the lap and lead lever and the valve clamped in central position on the disabled side, running the engine with one main rod. In this position the engine must be handled carefully to avoid slipping. If piston breaks inside of cylinder remove front cylinder head, taking out the broken parts, replace the cylinder head, disconnect the valve and clamp it in mid-position. The combination lever must be disconnected from the top of the lap and lead lever, also the lap and lead lever disconnected at the bottom and tied to the back cylinder cock. For cylinder head knocked out would treat in the same manner.

(d) If lap and lead lever are broken remove the broken parts, also union link, tie the forward end of the radius rod to the running board, clamp the valve in mid-position and proceed on one side.

Q. 59. How would you disconnect if a lower rocker arm became broken? How for a broken transmission bar or hanger? How for a link block pin?

Ans. If lower rocker arm or transmission bar became broken would remove the broken parts, disconnect the valve rod, clamp the valve in mid-position, being careful to see that link cleared the broken parts. For broken transmission bar hanger would block link block solid in the link is such a position that would enable the engine to handle the train. For broken link block pin would treat the same as for lower rocker arm, except in case of an emergency where it might be possible to substitute a bolt in place of the pin for a short distance.

Q. 60. When necessary to block a crosshead how would you do so and what would you guard against?

Ans. As a rule, would block crosshead securely in back end of guides guarding against the pin on front wheel clearing the crosshead, also on some old classes of engines would guard against moving the crosshead too far back to prevent the packing rings falling into the counter bore.

Q. 61. With one link blocked up what must you guard against?

Ans. Would guard against reversing the engine without moving the blocks.

Q. 62. What must be done if engine truck wheel or axle breaks?

Ans. The method in which this work should be done must be governed by the nature of the breakage. Where a piece is broken out of one wheel the broken part of the wheel can be turned uppermost and that pair of wheels stopped from turning, sliding them into the side track. Where a wheel is entirely gone chain the corner of the disabled truck to the engine frame, stake up the engine frame and block under corner of truck. Repeat this until the truck is up high enough, then chain the broken corner of the truck to the engine frame and cross chain from broken corner of engine truck to opposite side of engine frame, also block over good engine truck on the same side and under engine frame. This is for the purpose of relieving some of the weight of the chain. Still another method is to skid the disabled corner up on a tie chaining in the same manner as described.

Q. 63. State your method of treating a broken tank truck wheel or axle?

Ans. Where back axle breaks both corners of the tank can be staked up and that pair of wheels taken out, a timber placed across on the rails under the back corners of the frame and chained to the engine truck. In this manner the engine can be moved slowly into the side track. In the event, however, of a journal burning off letting one corner of the truck down, that corner of the truck can be chained in some cases to the iron work of the tank.

Q. 64. How would you block for a broken engine truck spring or equalizer? How for a broken tank truck spring?

Ans. Stake up one corner of engine truck and place a block on equalizers under top rail of engine truck frame, then stake up the other corner of the engine truck, placing another block in the same manner. For broken equalizer would stake up one corner of engine truck and place blocks over engine truck box, treating the other corner of the truck in the same manner. For broken tank truck spring would stake up the tank, then pry up body bolster and place blocking in place of spring. If spring was above the truck would block between bottom of tank and top of truck.

Q. 65. How would you move an engine if reverse lever or reach rod was caught at short point of cut-off by broken spring or hanger?

Ans. Would disconnect the reach rod

from the tumbling shaft arm, or in the event of this being so tight that it could not be disconnected would disconnect one of the link hangers or valve rod and run engine up on block, free the reach rod, remove the broken parts, connect up my valve gear again, do the necessary blocking and proceed.

Q. 66. Explain how you would block up for a broken spring, spring hanger or equalizer on the different classes of engine now in use on the road?

Ans. In the event of a broken spring, spring hanger or equalizer on an eight, ten-wheel or trailer engine it is generally advisable to place blocking over the back driving box, if there is any room, then run the back driver up on a wedge and place blocking over main driving box under top rail of frame, then, for ten-wheel or trailer engine, run back wheel down and main wheel up. If the equalizers can then be pried in place and blocked or chained it might be well to do so. If the frame is not up high enough blocking can be placed forward and back over front and back box, then the engine may be run to the rail when it may be necessary to run the wheels up on the wedges again in order to relieve the weight sufficiently off the spring rigging to permit their being pried into place. On eight wheeled engines, in order to place blocking over the back box, the back end of the engine can sometimes be staked up in preference to running the front wheel up on high blocks, as there is some danger of throwing the front casting out of place. On the large modern engines, in many cases, spring hangers are provided, or rather what is termed safety hangers, for the purpose of catching equalizers and preventing them from dropping down too low. Where it becomes necessary to block for broken spring or spring hanger on one of the large modern engines such wheels as will free the spring rigging should be run up on wedges and blocks placed over the driving boxes and equalizers pried into place the same as any other class of an engine.

Q. 67. (a) Should one of the forward tires on a ten-wheeled engine break, what must be done to bring the engine in?

(b) If the main tire?

(c) If back tire? What can be done?

Ans. (a) Remove the cellar if convenient, if not leave it in. Run the wheel up on a wedge block between the jaws of the box and the pedestal binder, also block under cellar or between journal and pedestal, providing the cellar is removed. Also place blocking in spring saddle if overhung engine and if underhung chain end of equalizer next driving box to lower rail of frame, cut out the driving brakes and proceed.

b. Proceed in exactly the same manner as for forward tire except that both equalizers on underhung engine must be chained to the lower rail of the frame in order to relieve the weight.

c. Run back wheel up on wedge, remove the cellar if possible, block in place of cellar with wooden block, block solid between jaws of box and pedestal binder, also under journal. Place block in spring saddle if one is used. If driving box equalizer is used place block under forward end of driving box equalizer above second rail of frame in order to relieve the weight of that box. If for a very short distance blocking may be placed over main driver, or if long distance the disabled corner of the engine should be chained to a tie, one end resting on the deck of the engine, the other on the tank. By removing the apron the chain can be passed up between the engine and tender also cross chain from the disabled corner of the engine to the safety chain on the tank to keep the good wheel from dropping off the rail.

Pumps Failed to Work—Results: Invention of Barometer.

Among the scientific questions that have reached this office is: "What is the Torricelli tube and who was Torricelli?" The answer necessarily calls for particulars about a great discovery and a highly important inventor.

The ancient belief was that water rose to follow the piston of a pump because "Nature abhorred a vacuum." For many centuries of a civilized world that explanation was regarded as satisfactory.

But "the world do move," as the colored sage remarked, and it happened about the year 1640, a deep well had been sunk in Florence, Italy, and it was found that the pump would not raise the water from a greater depth than thirty-two feet. The suction pump is of great antiquity, and is said to have been invented by Ctesibino of Alexandria about the year 230 B. C. But notwithstanding its great age the pump would not abhor a vacuum with sufficient intensity to raise water more than thirty-two feet, and that fact was not discovered or made widely public until the difficulty with the Florence well was encountered.

The practical water raising artisans of that day being vanquished they naturally applied to the man of science, who happened to be Galileo who had become famous through first establishing the value of the vibration of the pendulum as a means of measuring time, and also had discovered the law of falling bodies and other laws relating to natural phenomena, so that he has properly been regarded as the father of modern scientific methods. But with all his knowledge Galileo was unable to explain why the pump would not raise the water from any depth, and being within a few months of the end of his life he did not care to undertake new investigations, but he commended the solving of the mystery to a friend, Torricelli, a young philosopher.

Torricelli at once took up the investigation of the mystery, which by this time was exciting the learned men of Florence. To experiment conveniently, Torricelli employed a long glass tube and used different fluids which brought the knowledge that the height of the column depended upon the specific gravity of the fluid. He closed the tube at one end and filled it with mercury. Then he placed his finger on the open end and dipped in a basin of mercury and holding it up vertically, permitted the contents of the tube to settle.

It was then found that a column of mercury $27\frac{1}{2}$ inches high stood in the tube. On comparing the height of this column of mercury with the height of the column of water raised by the pump, it was found that the heights agreed in an inverse ratio of the specific gravities of water and mercury. It was then natural to reason that both columns were suspended by the pressure of the atmosphere.

Further experiments proved that the height of the column diminished when the apparatus was taken up a mountain and also that it varied slightly with changes of weather. The inference of the latter was that the pressure of the atmosphere varied at the same place. To indicate this varying condition, Torricelli made a barometer of a glass tube charged with mercury, thereby inventing the Torricelli tube which forms the barometer. It is closed at the top and open at the bottom end which is immersed in mercury. All barometers are modifications of this invention. The invention was the result of knowledge, ingenuity and industry.

A Poor Guess.

A much bothered conductor on an east-bound car was asked by a chilly lady passenger to close the ventilators. As he had already been importuned to open them by a half dozen other patrons, he resorted to diplomacy. "Madam," he said, in a confidential tone, "I'd gladly close the ventilators, but unfortunately a health officer is aboard the car, and he insists that they must be left open. I'd make myself liable to a lot of trouble if I opposed him." "A health officer?" said the lady. "Yes, ma'am," replied the conductor. And then, intoxicated by the success of his scheme, he unhappily added, "That's the man three seats ahead the one with the brown derby." The lady looked, and a change came across her face. "The one with the brown derby?" she repeated. "Yes'm; they say he's quite an expert on germs and things. I believe he is a German gentleman." The lady stared at the conductor. "He's nothing of the kind," she snapped. "The man with the brown derby is my husband!"

Air Brake Department

Triple Valve Tests.

In accord with the general advancement of air brake art we were inclined to be under the impression that all freight car triple valves, and practically all locomotive triples valves and distributing valves, were now being subjected to a thorough test on an improved test rack, after being cleaned and before being returned to service.

Observing the operation of cleaning some triple valves on passenger cars, and on some freight cars in interchange service a short time ago, has rudely shattered our illusions. The removable parts of the triple valves were cleaned, oiled, and replaced without removing the triple valves from the cars and without making any test other than that they would receive after the locomotive was coupled to the train.

At the present day this practice is inexcusable, in fact, it should be a criminal offense, we are inclined to think that it is, or rather, that the parties responsible for such a state of affairs are guilty of a misdemeanor that should be punishable by a fine and imprisonment. If a case of this kind was decided in equity, this would likely be the outcome when the possible consequences of this character of work was outlined before a judge and jury.

We say this advisedly rather than on the spur of the moment, and will endeavor to state why this practice may be the direct cause of a train wreck and loss of life.

The average air brake man needs no explanation on this point, and the Inspectors of the Interstate Commerce Commission are no doubt unaware that such practices are still in existence, but for the benefit of those who are constantly entering upon the repair work on triple valves, or rather those that are just entering upon this line of work, we will point out a few reasons why accurate and reliable inspection of triple valves cannot be made without removing the triple valve from the car and keeping it out of service until it has passed the prescribed test on the standard test rack.

In the first place, triple valve piston packing ring leakage is always liable to cause a stuck brake, overheated and bursted wheels, which may result in wreck and loss of life. Undesired quick action at a critical time is liable to part a train, cause a wreck or throw some one from the roof of a car, and to prevent, so far as possible, the condition of the triple valve from being a factor in the breaking of wheels or the parting of trains, an accurate and reliable test of the efficiency of the triple valve is necessary after every cleaning.

Triple valve packing ring leakage cannot be detected with the eye, and the amount of leakage can only be determined by test. The triple valve test on the modern rack approximates severe service conditions; that is the triple valve undergoing the test is subjected to the average conditions met with in operating the brakes on 100 car trains, the rise and fall of pressure is graduated to correspond with the brake valve reduction on the modern freight train.

The sensitiveness to quick action, and the fit of the emergency piston are determined by a test that corresponds to actual service conditions, frictional resistance and the capacity of the service port are accurately gaged, and packing ring leakage is shown in pounds per minute.

The writer has cleaned and repaired many triple valves that appeared to be perfect to the eye, but which failed to pass the test on the rack. A ring may be perfectly fitted, but if the piston bushing is worn a trifle, the valve will not pass the ring test, in fact, the test is so close that the slight shoulder in the bushing may be worn out, and a second ring fitted to pass the test, but the original ring will not. Again, the ring and bushing may both be perfect, but if the ring is a trifle loose in the groove it will not pass the test, so it is evident that repair work must be practically perfect, or some unfair practice must be used to get the valve past the test rack.

One of the most prolific causes of undesired quick action is, or has been, the restricted service port in the triple valve, the restriction is between the slide valve bushing and the body of the valve. The repairman cannot locate or remove the restriction without forcing out the bushing, hence the absolute necessity of the test rack.

The foregoing may not meet with the entire approval of the repairmen who work on locomotive repairs alone, as this accuracy of ring fitting is not so closely observed; that is, some repairmen will cite instances where they have been compelled to continue triple valves in service that had packing rings with over an eighth of an inch opening at the ends of the ring, or where they have even allowed triple valves with broken rings to pass and never had any further reports on them, but they will remember that the rise and fall of brake pipe pressure on the locomotive during application and release is very rapid as compared with the rise and fall 100 cars back in the train, and at the present time an engine helping a train has the air hose coupled up and its triple valves or distributing valve operated by the lead engine, therefore the necessity for accurate repair work on locomotive distributing and triple valves as well as car brake equipments.

As an illustration of the dangerous character of a "kicker" or "dynamiter," let us assume a long train to be moving at a moderate rate of speed and that following a heavy application, a quick recharge and re-application of brakes was imperative.

Such a requirement would necessitate an overcharge of the head brakes on the train and if one of the triple valves on the overcharged cars was to work in quick-action upon the following reduction, quick-action would occur on the head cars and probably a light service application on the rear ones and the consequences would depend upon a variety of conditions, but it would not be anything marvelous if the train was buckled and wrecked from a run-in of the rear cars.

In the Westinghouse Air Brake Company's shops, the men who fit up air brake apparatus, particularly triple valves and distributing valves, are expert in their particular specialty and railroad repairmen who work on all classes of air brake work cannot compete with those men in accuracy of fit, finish or output, and this fact is well known to the air brake manufacturers, nevertheless, should any of the triple valves be boxed for shipment before being subjected to the standard test, it is very likely that someone would be out of employment as soon as the fact became known. If the W. A. B. Co. cannot depend upon their repair work to measure up to the requirements without the standard test, it is absurd for any railroad company to expect satisfactory repair work without the test rack.

Test Rack Differential Valve.

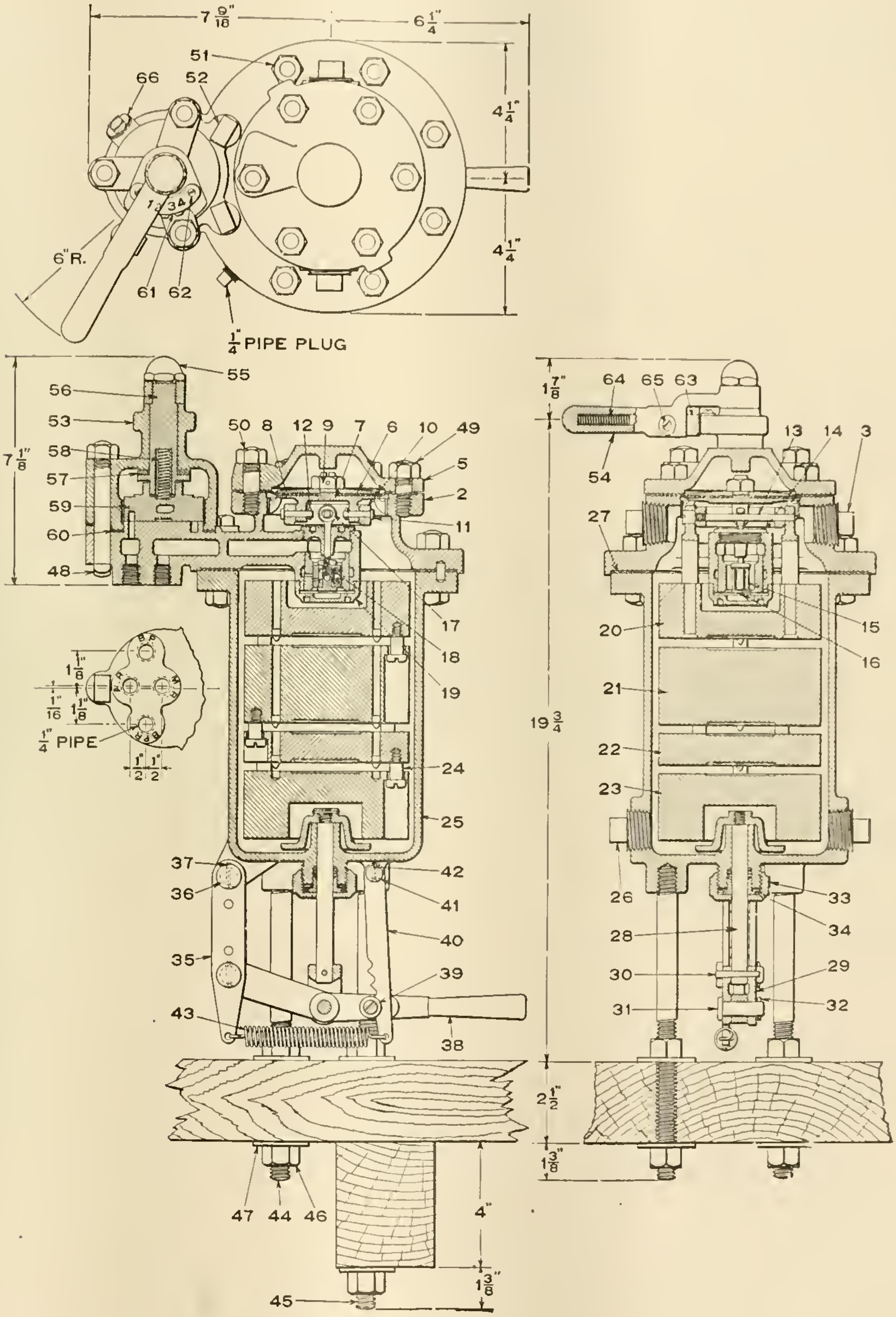
We have had some inquiries concerning the operation of the differential valve of the triple valve test rack which we have answered in the usual manner,

and for the benefit of those who have never seen the interior of one we show views of the structure.

The valve handle attached to a rotary valve establishes and cuts off communications between the main reservoir and the auxiliary and in different positions, alternates brake pipe and auxiliary reservoir pressure under and above the diaphragm to which the vent valve is attached.

The weights are also attached to the diaphragm and the illustration shows how the number of weights suspended from the diaphragm can be varied by the position of the lever D at the bottom of the valve body.

If the pressure under the diaphragm, whether brake pipe or auxiliary reservoir, exceeds the pressure above it, plus the weight of the number of discs suspended during any of the tests, the vent valve will be lifted to exhaust pressure from the vent port, which gives warning of undue resistance to any movement. Similarly this vent must be obtained to insure the proper differential between brake pipe and auxiliary pressures during the packing ring test.



TEST RACK DIFFERENTIAL VALVE.

Stopping Freight Trains.

Last month we printed a portion of a paper prepared by Mr. F. B. Farmer, of the Westinghouse Air Brake Company, on the subject of break-in-two trains. The entire paper can be found in the Proceedings of the Twentieth Annual Convention of the Air Brake Association, which is now almost ready for distribution, but we wish our readers to study the instructions for freight train handling which are the conclusion of the paper.

If a copy of this paper could be read by every operating official of American railroads it would be but a very short time until the mechanical men would be compelled to study and carry out the instructions relating to train handling which, if adhered to, would practically eliminate the break-in-two of trains due to rough handling and careless inspection of draft gear.

It is not impossible that broken trains and slid flat wheels, like the poor, will always be with us but if anyone will go into this subject as thoroughly as Mr. Farmer has, it will become obvious that break-in-two of freight trains can be avoided up to the point of accident or possible emergency, but is not likely to be for some years to come owing to a lack of knowledge of essentials and inability to obtain the necessary co-operation of everyone involved which, by the way, ranges from the general manager to the car inspector.

Mr. W. V. Turner has demonstrated, and proven to our entire satisfaction, that a freight train can be stopped with the air brake with less shock than the minimum encountered in stopping the more rigid and closer-coupled passenger train, but we understand that it will not be done as long as the additional slack in a freight train is perverted to create a shock instead of absorbing it. To the intent that our readers shall have an opportunity to learn in a measure what is required in the way of train handling, we follow this with Mr. Farmer's instructions for freight engineers.

"The secret of smooth train handling lies in the ability to control the slack, in how to prevent it from running in or out harshly. Where so controlled no draft gear in fair to good condition will be damaged.

"Slack action cannot be prevented, but by engineers acquiring knowledge of the various causes for it and exercising forethought in the use of steam, train brakes, independent engine brake and sand it can generally be controlled, even to the extent of avoiding further injury to damaged draft gear.

"The heavier the locomotive, and the longer the train, the greater is the care required. Harsh running out of slack is the usual trouble. About 40 per cent. of the break-in-twos occur within ten cars of the engine. Slack is run out by the use of steam as well as of brakes. A train made up with empties behind loads is not an excuse for breaking in two; neither does it follow that an 'old defect' is, both proven by the records of some engineers. Intelligent observance of the following instructions will aid others in verifying this.

"Excessive slipping of drivers causes severe shocks to draft rigging. The coupler springs cause the slack to change quickly, and this is usually followed by a severe shock with the renewed use of steam. Hence, when slipping is probable, use sand. Also, when working an engine heavily at slow speed use no more throttle than necessary. Full power is then obtained with a moderate opening. The beginning of slipping will instantly reduce the steam pressure in the cylinders and, with the quick and slight closing of the throttle then possible, will at once 'steady' the engine without much slack running in or loss of speed. With two or more engines in a train, excessive slipping of one will often cause the other or others to slip.

"In slacking to start a train, endeavor to take either a foot or two or the slack of the entire train. Take but little if slacking the entire train will allow the rear end to run back, as an attempt to take all then will almost certainly cause damage. With a helper at the rear any slacking should be done by the helper engineer, the head engineer keeping the throttle open moderately, but prepared to temporarily ease off enough to prevent a lunge when he is started. With two engines ahead the second engineer should allow the head one to start the train, or, if possible, to almost stall before aiding him. Starting together will cause a severe shock if any slack is in.

"Bear in mind the importance of time on slack action. Slack cannot be changed *gently* and *quickly*. *In starting a freight train keep the engine at a slow and uniform speed for two car-lengths,* and don't vary this rule because less distance *may* have started the entire train. Form a habit in this. Also, where use of the brakes is changing the slack condition, allow ample time for the slack action to be completed before doing anything that would hasten it. As one illustration, when releasing the train brakes while running, do not commence to use steam until certain the slack has had ample time to run out, and even then start its use gradually. Another is where, when running forward, steam is shut off and brakes are applied; allow ample time for the slack to run in before applying the brakes. Even then make a light reduction if the speed is low. An example of wrong operation and results: where a long train has just been started, and while the engine is working heavily, if it is shut off suddenly and a heavy service application is made, there is liability of driving in couplers or even of 'jack-knifing' any weak car near or ahead of the middle of the train.

"Remember that compressed car coupler springs (slack either in or out heavily) react strongly, and that where the brakes, the grade or use of steam act in the same direction on the slack, very severe shocks will follow. An example is releasing the train brakes, at even moderate speeds, just before or about the time a service reduction is ending, as the reduction will have bunched the slack. When moving forward slack out is more favorable for releasing, as slack in is for applying.

"When stopping a long train while backing at moderate or low speed use a light reduction, keep the engine brakes from applying and continue to use steam. The object is to prevent the slack from running out harshly.

"How rapidly any certain brake action will change the slack depends on the speed, because brake shoe friction is better as speed is lower. This is why the slower-releasing rear brakes will generally cause a break-in-two on attempting to release at low speed, yet will not cause any appreciable shock when release is made at the higher speeds. The following instructions for stopping long trains from ordinary speeds are based on this and the further fact that, at any certain speed, the possible difference in holding power between the two ends of the train will be less the lighter the service application.

"Attempt no 'spot' stops. This means do not endeavor to run up close to a switch to head in, and to always stop short and cut off for coal and water. *The main object is to stop properly* within any reasonable distance short of the switch, the water tank or the coal chute. This cannot be done *regularly* and, at the same time, stop the engine at some desired spot.

"Shut off steam gradually and allow ample time for the engine to drift in the slack as much as it will before commencing to apply the brakes. With a drifting throttle use no more steam than necessary and none below 7 or 8 m. p. h. If set when at normal speed and not changed, the engine will be working hard when speed is low.

"At ordinary speeds make each stop with *one* application but with *two* reductions. Make the first reduction sufficient and at a point to insure that it alone will, with no additional reduction, prevent the engine from passing the objective point. Take all chance of error in judgment on the side of stopping too soon. Then, when not over 40 feet from stopped, make the second reduction of 6 or 7 pounds. The only object of this second and final reduction is to start the slack in at a time too late for it to run out again before the stop is completed, thereby reducing possible strains on the draft rig-

ging and bunching the slack more or less for starting. It must not be made much earlier than directed as to do so is liable to cause a break-in-two, rather than avoid one. When made properly the brake valve will be discharging when the engine stops. If the grade permits, release may be commenced as soon as the train is stopped and without waiting for the brake valve discharge to cease.

"If the slack stayed in after the first reduction no harm would result from making more reductions between it and the final one, but the engineer cannot know how the slack will be with any train other than one with empties behind loads. With the latter the slack is sure to stretch after each reduction but the one made within 40 feet of stopped, and this *may* be true of any other make-up. With slack out each reduction *starts* it in and is followed by it running out. The slower the speed and the greater the reduction the heavier will be the run-in and the following run-out; hence, the worse the jerk. Therefore, the only *safe* method for all freight trains is the one instructed.

"The amount of the initial reduction should suit the speed of the train and the grade, must not be less than 7 lbs. nor over 12 lbs. For speeds of 15 m. p. h. and less use 7 or 8 lbs. Above 15 m. p. h. use as much less than 12 lbs. as conditions will warrant. The objects sought are to have all slack action take place at the higher speeds, so as to insure that it will be gradual, at the same time to permit it to adjust itself however it will, and then to not disturb it by farther reductions until the final one.

"An exception to the rule of one application for stopping a freight train is where speed is very high, particularly where the stopping place is a meeting point or a railway crossing; in fact, any place where additional hazard would follow lack of entire control. Under such conditions a reduction of about 12 lbs. should be made far enough from the objective point to permit of slowing the speed to between 25 m. p. h., not lower than 20, and of releasing and recharging quite thoroughly before reaching the place where the regular application for stopping should be begun. This is not to countenance such speeds, but is to provide for safety in stopping where they occur.

"Do not assume the presence of K triple valves will permit of releasing at low speeds unless the forward 25 cars have these valves and cut in.

"Where reasonably efficient retaining valves are in use, it is practicable to release at somewhat lower speeds than when they are cut out. While the head brakes always start to release before the rear ones the retaining valves cause a much slower fall of brake cylinder pressure than when they are not in use and this causes the slack to run out more gradually.

"Speaking generally, all stops should be made with the train brakes, experience having demonstrated that rough work too frequently accompanies stopping with the independent engine brakes because the power of these brakes on a modern freight locomotive and the *time* necessary to run the slack in or out gently are either not appreciated or the knowledge is not used. One of many possible examples of abuse is stopping a freight train with the engine brakes on even a gently-ascending grade, having these brakes heavily applied at the stop and left so. The coupler springs and the grade then run the slack back so rapidly as to break the train in two. Gradually reducing the brake application as the speed gets low, and having none on at the stop would avoid this trouble.

"Do not hold a train with the train brakes for over ten minutes on a grade where brakes are required to prevent movement. The engine brakes alone will hold a very heavy train on a steep grade if the position of the slack is such as to prevent cars from starting when the train brakes are released, e. g., all slack in at the stop on a descending grade. Always keep the independent brake fully applied when oiling, taking water or coal."

In addition to this the reader will note that Mr. Farmer recommends 6 or 7 lbs. for the final reduction, which if correctly timed, is equivalent to the full service reduction in gaining the objective point sought in or during the stop, that is, if correctly made the brakes will be applying on the head end as the train comes to a stop and the lesser reduction tends to facilitate the following release of brakes.

Prime Factors in Draft Gear.

In the course of a discussion at the Western Railway Club of a paper on Testing of Draft Gear by Mr. Bruce V. Crandall, Mr. W. E. Symons said: "The prime requirements of a draft gear are, capacity for absorbing and destroying shocks to relieve the underframe; initial resilience to permit an easy starting of the train; flexibility between maximum and minimum, or easy working between maximum and minimum, because of its effect on the drawbar pull and moderate release to prevent break-in-twos.

"On this one paragraph alone an exhaustive monograph could be written on Draft Gear, and still leave many points untouched, as its treatment embraces both engineering and operating questions, on which there is not only a diversity of opinion among our best authorities, both from a theoretical and practical standpoint, but also involves important features that have received little or no consideration from those who design or manufacture gears, and is almost entirely overlooked in railway operation, and that is the question of combined Impact and Velocity.

"As a rule draft gears are designed by mechanical engineers or draughtsmen; if not the original thought, the detailed drawings are worked out by office men. The laboratory test of the working model is then reduced to graphic chart, showing a gear that will, without a shock or injury, absorb from 190,000 to 200,000 pounds, and as the limit of the Class G. M. C. B. spring is 60,000 pounds, the average consolidation freight engine about 45,000, and the largest Mallett's about 106,000 pounds, it is argued, and usually accepted as true, that a gear with such a high factor of reserve capacity is so far outside the danger zone as to leave no doubt of its indestructible character. It is purchased and applied on the above showing, and then the real show begins.

"The gear that showed such beautiful geometrical curve lines while under the care of a mechanical engineer in the laboratory, is smashed to smithereens as it were, by a switchman, when put to actual service conditions.

"The reason for this is, that, while the gear is being subjected to laboratory test, the resisting pressures recorded, showing its capacity, are slowly or gradually and evenly applied, the period of complete application occupying about 15 to 20 seconds, and sometimes longer. The testing machine, which corresponds to the car framing is of course in perfect alignment, so that the gears, regardless of their design, are given the best of an opportunity to develop the highest resisting power, without a possibility of showing defect or sustaining injury.

"When applied to a car, however, every known laboratory condition is changed, there being no feature surrounding the service test corresponding to that by which the results shown on graphic charts were produced.

"In the first place, the car framing, or superstructure, does not in any case approach in strength, rigidity, mechanical precision or construction, that of the testing machine.

"Second: Even when the cars are on a tangent, or straight track, the impact, or blows, resulting from two cars coming together are seldom, if ever, under the same conditions that would obtain with a single gear in the testing machine.

"Third: It is well known to every one in connection with the operation of a railway that there is a vast difference between a mechanical engineer or a professional gentleman, and a railway switchman. There is also a vast difference between the conditions under which they perform their respective duties. The professional gentleman, as previously stated, takes one single gear in the laboratory, and during a period of 15 or 20 seconds, or longer, very carefully and gently compresses it together; while the switchman throws a loaded car, or cut

of cars, down against other cars that are standing still, at speeds varying from one to ten miles per hour, and sometimes faster, the impact of the blow thus produced frequently amounting to 500 or 1,000 per cent more than anything ever approached in the testing machine, and it is all done inside of one second or less time. So that when a reasonably fair analysis or comparison is made of the conditions, the question of a friction, or any other draft gear, absorbing or destroying the shocks, and thus relieving the underframe of cars, resolves itself largely into a question of velocity.

"This is very clearly demonstrated in lines other than railway work. For instance, it is stated on good authority that a very frail pine lath, such as is ordinarily used in the construction of frame houses, was driven partially through a healthy young maple tree, about six inches in diameter. This tree was in the path of a cyclone in Kansas. The lath had been picked up from a lumber yard about a mile distant from the maple tree, and had struck it with such velocity that, although the pine lath was very soft, such as could almost be crumpled in one's hands, the lath had been driven partially through the tree. Another well-known man described having personally seen a heavy bridge girder through which a pine scantling 4x4, had been driven at the time of the St. Louis cyclone, it having punctured a hole slightly larger than the stick of timber, but free from any ragged edges. Numerous other similar instances could be cited, in all of which cases the real cause of the lighter object, or softer material, affecting the stronger, was due entirely to velocity. Thus velocity spells destruction.

"The term 'Draft Gear,' while descriptive of the mechanism by which railway cars are coupled and drawn, does not indicate the maximum resisting powers which this part of the equipment must withstand, and it has been suggested that a more appropriate title would be something on the line of 'Buffing Shock Absorbing Mechanism,' for it is quite clear to all operating officers, or others, who have taken the time and trouble to thoroughly study the situation, that the successful draft gear on cars today, or the best draft gear, is the one which can best withstand the buffing shocks. And the gear that yields the most readily to the buffing shocks in itself, or causes injury to other parts of the car, is the least desirable one to use, while the gear that will most successfully withstand these buffing shocks, either in itself or as an integral part of the superstructure, is the best gear, assuming that the prices are reasonable in both cases.

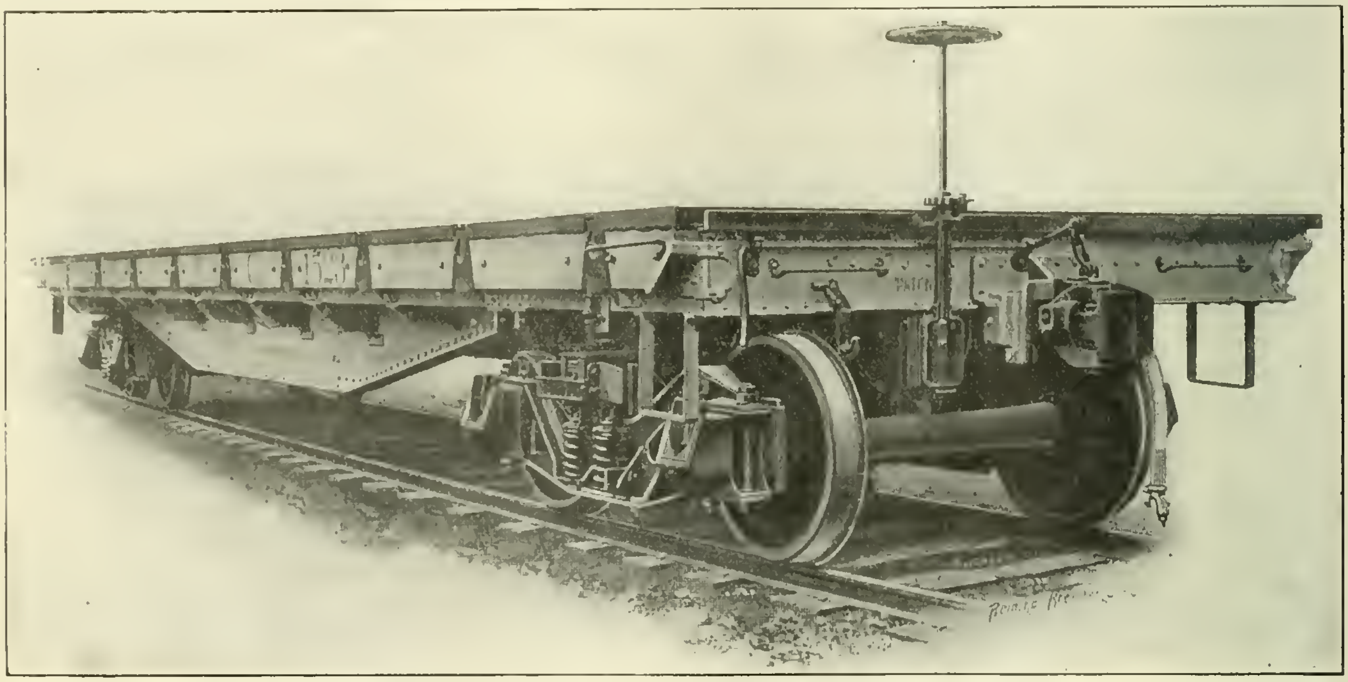
"Although this report was made some two or three years ago, it seems to me that the conclusions reached in this case are somewhat similar to the line of thought which prompted Professor Endsley, Mr. Seley and Mr. Barnum to speak on this subject, and is now offered as reflecting my views in a general way on this subject.

Undoubtedly they have certainly made great strides, but in regard to completely overcoming or entirely eliminating the damage to railway equipment and its contents by any kind of draft gear, I am inclined to think that we will have to be satisfied with minimizing the trouble rather than seeking to entirely eliminate it, which latter I believe is impossible."

Standard Car Trucks.

Last month we took the opportunity to describe the De Voy Engine Trailing Truck which bids fair to come rapidly into popular use on account of simplifying the parts necessary for a lateral action of trailer wheels under locomotive fire boxes. The De Voy truck, as well as all the company's trucks and devices, are the result of vast experience and natural development in meeting the requirements of engines and cars of increasing weight and capacity. It has been demonstrated that their trucks, side bearings, center plates and four-point bearing cars, ranging in capacity from thirty tons to one hundred and ten tons, have given maximum wearing results and are absolutely free from breakage.

The company has been in existence for nearly twenty years, and the mechanical appliances used in the extensive works have grown to such a degree of perfection that all materials are thoroughly tested, and run free from flaws common in foundry practice. The Barber four-point bearing steel underframe flat car, of which we give an illustration, is a new departure in car and truck construction, and a large number of these cars have been in service from one to five years, and have frequently been tested as high as fifty per cent over capacity, and all have records free from failure or derailment. The wear on wheel flanges has been reduced to a minimum. Truck and body bolsters reduce the weight and eliminate the possibility of breakage from load. It will be observed that the trucks are double action and designed for the four-point support. It is known as the Barber double action truck and there is no load carried on the center plate.



BARBER FOUR-POINT BEARING STEEL UNDERFRAME FLAT CAR.

At the Birth of the Brick Arch

During a discussion at a meeting of Traveling Engineers on the utility and usefulness of the brick arch as an aid to combustion, Angus Sinclair said:

I was in at the birth of the brick arch and I have practically seen the whole of its growth and development.

When I first went into the locomotive department the railways in Great Britain were very strictly prohibited from causing any smoke. In nearly all railway bills—that is, the same as you have charters—the agreement was made that they should cause no nuisance nor smoke from locomotives. In consequence of this they burned coke. That was the only way they knew that they could avoid the raising of smoke. However, after a few years experience with the locomotives and coke burning they found that it was very expensive fuel, and some of the roads began to experiment with bituminous coal, which is all the coal they have in the Britsh Isles.

A locomotive superintendent of the Scottish North Eastern named Thomas Yarrow, with whom I first went into the department, began experimenting with a brick arch. He had a mason build arches of ordinary brick. He would make a few runs with the brick arch, then a few runs without it; sometimes with coke for fuel and mostly with coal.

I went into the department as a telegraph clerk originally, and was selected to keep records of the fuel consumed by engines that were experimenting with the brick arch, so that I was in with the work really from the beginning. We ran with the brick arch and coal, making a few trips and weighing very carefully the coal and measuring the water. Then ran without the arch, and, as far as my memory serves me they found that there was a saving of about 20 per cent. by using the brick arch from what there was when they used the plain firebox. Well, the result was that all the engines on the road were equipped with brick arches and the same thing was done by really nearly all the railways in the British Isles.

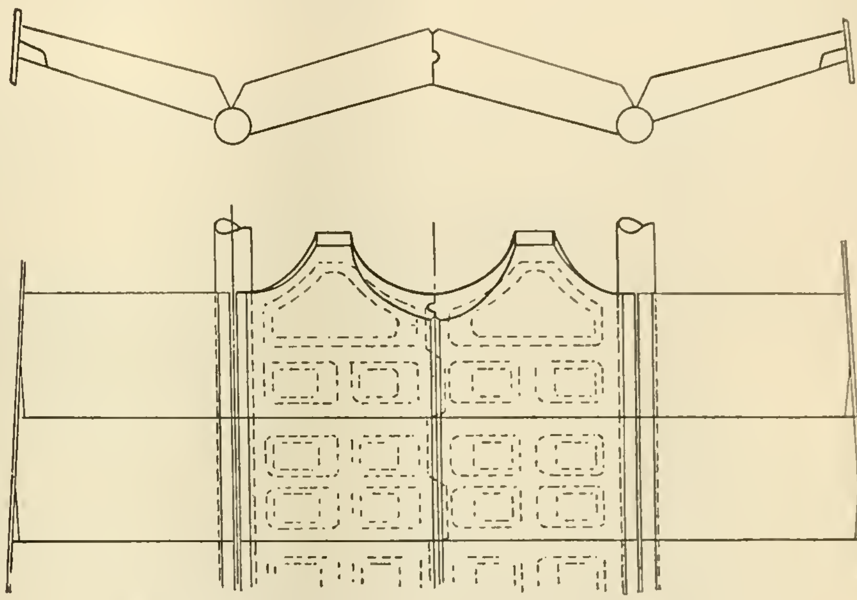
A variety of smoke-preventing devices were tried, quite a number of them worked fairly well, but finally the railways settled down to the brick arch and some means of admitting air above the fire. Those who are familiar with locomotive literature regarding railway appliances will remember that Kinnear Clark, the famous mechanical engineer, had a good deal to do with smoke prevention. He made an appliance for admitting air above the fire which is well known and is used to some extent in this country today.

In the course of time I got to firing and running on the road where the brick arch was first applied and had experience with the brick arch. It was perfectly satisfactory to the enginemen, and if anything happened to the arch the men would no more think of running without it than they would think of running without a firedoor. A great deal of care was taken in the selection of brick to ascertain that it was of durable quality. In my time it was always the common size of fire brick that was used; but, as I said, there was great care taken in the selection.

My experience in this country when difficulty with the fire-brick was experienced was that they used very inferior brick. The fire-brick used was not adapted for the great heat which the firebox was subjected to, and hundreds of failures resulted from that cause. It was not because there was any real objection to the brick arch, but the stuff the arch was made of. When I came to this country and began to get familiar with the methods and appliances, I was very much surprised at the absence of the brick arch, because I was familiar with its great advantages on the other side, where about that time it had became to be universally used. It was used in all countries of the world as the one thing that was necessary for the prevention of smoke and for increased evaporation of the coal—improved combustion.

When I joined the Master Mechanics' Association in 1883, the first year I was a member I had a dispute with one of the members of that organization about the brick arch. That man was James N. Lauder. He was mechanical superintendent of the Old Colony Railroad, and a power in the Master Mechanics' Association. Whatever Lauder said was likely to go, and he had an antipathy to the brick arch and never hesitated to express his view upon it. I took it up with him and found that Lauder's objection to the brick arch was, that it was adding something to the locomotive that was likely to go wrong. He reasoned this way: "Every additional appliance that you put on your locomotive makes an additional chance of failure and therefore I have no use for the brick arch." He finally gave in and said he was not above trying anything that was liable to improve the working of the locomotive and he would try it.

He had engines on the boat-train—from Boston to Fall River—about the same weight of train every day at the same speed. There were two engines employed on that train and he put a brick arch into the firebox of one and he was very careful to see that he got the same result the condition was calling for. After he had run them for two or three months, one with the plain firebox and the other with the brick arch, he decided that there was a saving of at least 20 per cent. in fuel with the use of the brick arch, and, I think, this was the beginning of the use of the brick arch in New England. Favor to the arch has come slowly, but it has come. I have been an apostle of it ever since I came here. I have never lost a chance of talking it, in season and out of season, and I think it has saved railways an immense amount of money if it could be calculated, and more than that, it has helped to keep down the constant demand for smoke prevention, and there will be enough of it in the end.



FORM OF BRICK ARCH IN USE ON THE BOSTON & MAINE RAILROAD.

Steam boilers were no sooner in use when the public began to say that they must be used without smoke. That is going on today and there is no method of helping to prevent smoke so effecually as the brick arch.

Electrical Department

Butte, Anaconda and Pacific Railway—2,400 Volts Direct Current Electrification.

The electrification of the Butte, Anaconda & Pacific Railway is one of the large installations of electrical equipment for steam railroad service and is of exceptional interest because it is the first in this country where direct current locomotives operating on as high a potential as 2,400 volts will be employed.

The adoption of the 2,400-volt direct current system for this railway was determined after a comprehensive study of local conditions and requirements. Service consists principally of hauling long trains of copper ore over heavy mountain grades. By the use of 2,400 volts unusual economies in initial expenditures were possible as the high voltage decreases the number of sub-stations and amount of copper wire several times below that required for 600 volts.

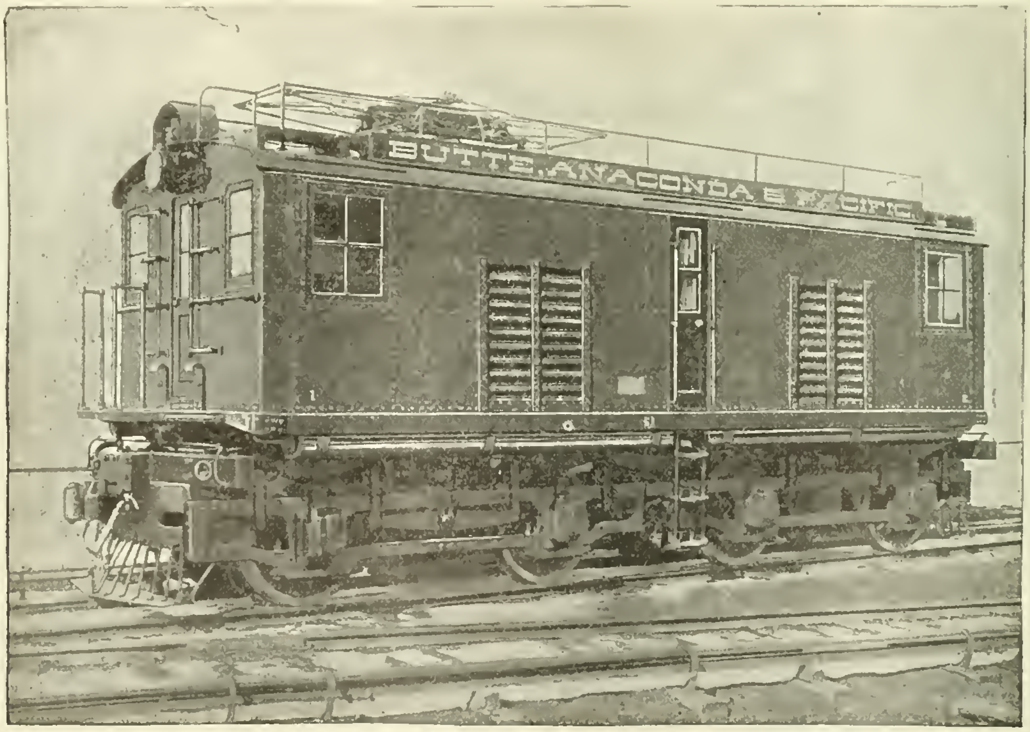
The section of the road that has been equipped lies between Butte and Anaconda, Mont. It comprises 30 miles of main line single track and numerous sidings, yards and smelter tracks, aggregating a total of about 90 miles on a single track basis. The haulage of copper ore from the Butte mines to the smelters at Anaconda, together with all mine supplies, lumber, etc., moving in both directions, amounts to practically 5,000,000 tons of freight per year. Complete freight trains weighing 3,400 tons are made up of fifty loaded steel ore cars and will be handled against a ruling grade of 0.3 per cent. by two of the locomotives coupled together and operated as a unit. Only one locomotive will be used for making up trains in the yards.

The initial equipment consists of seventeen locomotives of the 0-4-4-0, fifteen for freight and two for passenger service. Two of these freight locomotives will haul the 3,400-ton trains at a maximum speed of 15 m. p. h. against the ruling grade and at 21 m. p. h. on level tangent track. The passenger locomotives are of the same design as the freight locomotives except they are geared for a maximum speed of 45 m. p. h. on level track. A schedule of eight passenger trains per day, four each way, is maintained, the average train being composed of a locomotive and three standard steam road passenger coaches. All the locomotive equipment, as well as the sub-station apparatus and overhead line material, was designed and built by the General Electric Company.

The locomotives are the articulated double truck type with all weight on drivers. Each truck is built up of heavy steel castings. The side frames are of a truss pattern with heavy top and bottom members and pedestal tie bars.

An engineer's compartment is provided at either end. The central section contains the control apparatus with all parts and circuits carrying 2,400 volts thoroughly protected from accidental contact.

The motors, four in number, are the G. E. 229A, wound for 1,200 volts and insulated for 2,400 volts. It is therefore necessary to keep the motors permanently



BUTTE, ANACONDA & PACIFIC RAILWAY TYPE OF ELECTRIC LOCOMOTIVE.

connected in pairs, but each pair is treated like a single motor and for speed regulation are first connected in series and then in parallel. The motors are arranged for forced ventilation, air being forced through and around the armature and the field coils, keeping the motors at a uniform temperature. A forged pinion is mounted on each end of the armature shaft and meshes into a corresponding gear mounted on the wheel hub. The gear reduction is 4.84 on the freight locomotives and 3.2 on the passenger locomotives.

The control equipment on the locomotives is the well-known Sprague-General

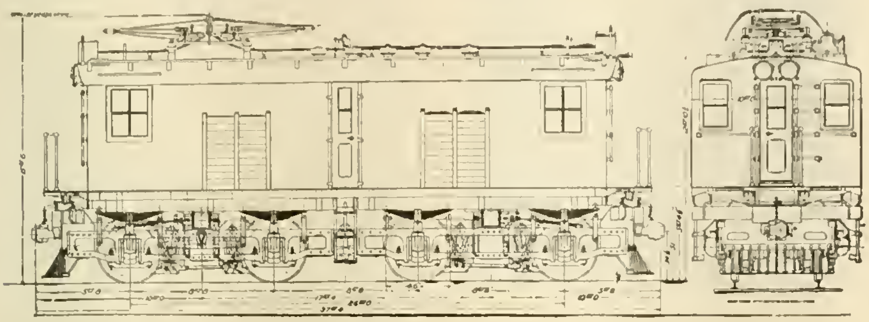
Electric Type M multiple unit control, and is designed to operate the four motors in series and series-parallel. The pairs of motors with their respective resistances are all connected in series on the first point of the controller. The resistance is varied through nine points on the controller and finally short-circuited on the tenth or running point. The pairs of motors are then operated similarly in series-parallel and all resistance is cut out on the nineteenth point, which is the full speed running point. This provides a control with ten steps in series and nine steps in series-parallel.

The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The smooth transition between control points permits acceleration close to the slipping point of the wheels. A switch is provided having manually-operated handles for cutting out either pair of motors, so that the locomotive can then be operated with one pair of motors in the usual way.

Current is collected by overhead trolleys of the pantograph type. They are pneumatically operated and can be put into service from either engineer's compartment by a hand-operated valve. Each passenger locomotive is equipped with two collectors, and each freight unit with one collector. A 2,400 volt insulated bus line connected direct to the pantographs is run along the center on the roof of the cab. The bus lines are connected by couplers between the two units of the freight locomotive, so that current is obtained from both collectors or from a single collector. The collectors and bus lines are adequately guarded by railings.

The principal data and dimensions applying to the locomotives are the following:

Length inside of knuckles	37 ft. 4 ins.
Length over cab	31 ft.
Height over cab	12 ft. 10 ins.
Height with trolley down	15 ft. 6 ins.
Width over all	10 ft.
Total wheel base	26 ft.
Rigid wheel base	8 ft 8 ins.
Track gauge	4 ft. 8½ ins.
Total weight	160,000 lbs.
Weight per axle	40,000 lbs.
Wheels, steel tired	46 ins.
Journals	6 ins. x 13 ins.
Gears, forged rims, freight locomotives	87 teeth
Gears, forged rims, passenger locomotives	80 teeth
Pinions, forged, freight locomotives	18 teeth
Pinions, forged, passenger locomotives	25 teeth
Tractive effort at 30 per cent. coefficient	48,000 lbs.
Tractive effort at one hour rating	30,000 lbs.
Tractive effort at continuous rating	25,000 lbs.



SECTION VIEW OF THE ELECTRIC LOCOMOTIVE FOR THE BUTTE, ANACONDA & PACIFIC RAILWAY.

Micarta.

A new material, known as micarta, to take the place of hard fibre, glass, porcelain, hard rubber, built-up mica, moulded compound, etc., has been developed and is manufactured by the Westinghouse Electric & Manufacturing Co.

It is of tan-brown color, is hard and homogeneous and has a mechanical strength about 50 per cent. greater than hard fibre. It can readily be sawed, milled, turned, tapped, threaded, etc. It is not brittle and will not warp, expand or shrink with age or exposure to the weather.

One of the two grades manufactured known as Bakelite micarta will stand a temperature of 300 degs. Fahr. continuously and 500 degs. Fahr. for a short period. It is infusible and will remain unaffected by heat until a temperature sufficient to carbonize it is reached. It has a very low coefficient of expansion, being approximately .00002 per degree centigrade. It is insoluble in practically all ordinary solvents such as alcohol, benzine, turpentine and weak solutions of acids and alkalis.

The wonderful properties of this material will make it indispensable in the manufacture of electrical apparatus, for insulating materials are required that will not only be a good non-conductor of electricity but that will be able to maintain this high insulation although subjected to moisture, heat, etc., and at the same time be mechanically strong.

Norfolk & Western Railroad Electrification.

The plans for the electrification of this railroad call for the handling of freight trains only over the electrified section of about 30 route miles. Very heavy coal business is hauled over grades of from 1.5 to 2 per cent., the trains averaging in weight 3,250 tons. At present three mallet engines, one at the head and two pushing, are required to haul these trains at a speed of 7½ m. p. h.

Passenger trains, for the present, or though merchandise freight will not be handled by electricity. By use of electric locomotives the 3,250-ton trains can be operated at 13 miles per hour up the heaviest grades.

Small Motors.

The use of small motors of less than one horsepower and ranging from 1/30 h. p. to ⅛ h. p. is rapidly increasing. For example the Hamilton-Beach Manufacturing Company have put 20,000 of these motors out in drink mixers. Motors have also been applied to portable grinders for machine shops, hair and shoe driers and fans. The diversified applications of fractional horse power motors have produced a large number of entirely new electrical devices, among which is a drier made especially for shoe-cleaning stands

Direct Connected Motor Driven Planers.

The reversing motor, designed so that it can be reversed at full speed at full voltage has made possible the direct connected planer. Although the idea of applying reversing motors has been in existence for eight or ten years, it is only recently that the motor has been perfected and placed on the market. The electric drive for planers is worthy of special study, for by its use new records can be obtained in machining castings.

Templates.

If more railroad companies would establish, in connection with their mechanical headquarters a place where templates would be made by expert workmen for the use of all the shops in the system, it would be the best paying enterprise we could conceive. The templates would be made by men accustomed to accurate working, with good instruments of precision to keep the measurements correct. The development of such a practice would secure uniformity for all parts that were made to the templates.

A template making department could be established at small cost and its usefulness would soon be demonstrated, not only in point of exactness but in the matter of economy.

Items of Personal Interest

Mr. W. M. Briggs has been appointed master mechanic on the Arkansas & Gulf, with office at Taark, La.

Mr. T. R. McLeod has been appointed master mechanic of the Central Ontario, with office at Trenton, Ont.

Mr. E. M. Lambert has been appointed master mechanic on the Gilmore & Pittsburgh, at Armstead, Mont.

Mr. D. O'Brien has been appointed master mechanic of the Kansas City & Memphis, with office at Rogers, Ark.

Mr. S. R. Maulden has been appointed master mechanic on the Illinois Central, with office at Water Valley, Miss.

Mr. B. Ferris has been appointed general foreman on the Detroit, Toledo & Ironton, with office at Delray, Mich.

Mr. J. W. Sasser has been appointed master mechanic on the Tampa Northern, with office at Jacksonville, Fla.

Mr. W. R. Walsh has been appointed road foreman of engines on the Michigan Central, with office at Detroit, Mich.

Mr. G. F. Wieseckel has been appointed master mechanic at the Western Maryland, with office at Hagerstown, Md,

Mr. C. R. Asked has been appointed master mechanic of the Greene County railroad, with office at Bostwick, Ga.

Mr. R. E. Bannin has been appointed general foreman on the Chicago & Eastern Illinois, with office at Danville, Ill.

Mr. L. V. Gartnier has been appointed motive power inspector on the Baltimore & Ohio, with office at Pittsburgh, Pa.

Mr. Edward English has been appointed master mechanic on the Great Northern, with office at Grand Forks, N. D.

Mr. J. A. Stewman has been appointed master mechanic of the Lancaster & Chester, with office at Lancaster, S. C.

Mr. J. W. Walker has been appointed general foreman on the Chicago & Northwestern, with office at Belle Plaine, Ia.

Mr. William Austin has been appointed master mechanic on the Lorain, Ashland & Southern, with office at Ashland, Ohio.

Mr. H. P. Roby has been appointed road foreman of engines on the Bangor & Aroostook, with office at Bangor, Me.

Mr. W. H. Dyer has been appointed master mechanic on the Georgia & Florida, with headquarters at Douglas, Ga.

Mr. M. K. Barnum has been appointed general mechanical inspector on the Baltimore & Ohio, with office at Baltimore, Md.

Mr. Fred Judy has been appointed road foreman of engines on the Morgantown & Kingwood, with office at Morgantown, W. Va.

Mr. W. A. Yanda has been appointed machine shop foreman on the Minneapolis & St. Louis, with office at Marshalltown, Iowa.

Mr. Joseph H. Nash has been appointed superintendent of motive power on the Illinois Central, with headquarters at Chicago, Ill.

Mr. F. Schorndorfer has been appointed general foreman on the Baltimore & Ohio Southwestern, with headquarters at Chillicothe, Ohio.

Mr. F. M. Young has been appointed general foreman on the New Orleans, Mobile & Chicago, with headquarters at Laurel, Miss.

Mr. D. A. MacMillan has been appointed general air brake inspector on the Northern Pacific, with headquarters at St. Paul, Minn.

Mr. S. F. Hanchett has been appointed road foreman of equipment on the Chicago, Rock Island & Pacific, with office at Trenton, Mo.

Mr. F. T. Hyndman has been appointed superintendent of motive power of the Wheeling & Lake Erie, with office at Cleveland, Ohio.

Mr. F. M. Roberts has been appointed traveling engineer on the Minneapolis, St. Paul & Sault Ste. Marie, with office at Wishek, N. Dak.

Mr. C. E. Segrest has been appointed general mechanical inspector on the Louisville & Nashville, with headquarters at Fargo, N. Dak.

Mr. E. A. Park has been appointed superintendent of motive power and engineer of the Peoria & Pekin Union, with offices at Peoria, Ill.

Mr. A. Headley has been appointed general foreman of the car department on the Duluth & Iron Range, with office at Two Harbors, Minn.

Mr. W. T. Bryant has been appointed road foreman of engines on the Richmond, Fredericksburg & Potomac, with office at Richmond, Va.

Mr. J. S. Beyer has been appointed master mechanic of the Augusta Southern, with office at Charleston, S. C. He succeeds Mr. E. Fuller.

Mr. J. Miller has been appointed general foreman of the locomotive department of the Burnside shops of the Illinois Central at Chicago.

Mr. R. H. Flinn has been appointed general foreman of the Louisville division on the Pennsylvania lines West, with headquarters at Louisville, Ky.

Mr. J. E. Osmer has been appointed superintendent of motive power and master car builder on the Manistique & Lake Superior, with office at Owosso, Mich.

Mr. Frank Buchanan has been appointed traveling engineer on the Chicago, Milwaukee & St. Paul (Puget Sound Lines), with headquarters at Seattle, Wash.

Mr. F. Ritner has been appointed master mechanic of the Cincinnati, Georgetown & Portsmouth, with office at Cincinnati, Ohio. He succeeds Mr. George Conrad.

Mr. C. M. Starke, formerly master mechanic on the Illinois Central at Water Valley, Miss., has been transferred to a similar position on the same road at McComb, Miss.

Mr. George W. Robb, formerly master mechanic on the Grand Trunk Pacific at Prince Rupert, B. C., has been transferred to a similar position on the same road at Transcona, Man.

Mr. A. G. Armstrong has been appointed master mechanic of the Atchison, Topeka & Santa Fe Coast Lines, with office at Needles, Cal. He succeeds Mr. N. P. Cheney.

Mr. J. E. Murphy, formerly general foreman on the Chicago, Burlington & Quincy, at McCook, Neb., has been transferred to a similar position on the same road at Sheridan, Wyo.

Mr. F. W. Wilson, formerly road foreman of equipment on the Chicago, Rock Island & Pacific at Cedar Rapids, Ia., has been transferred to a similar position on the same road at Manly, Ia.

Mr. H. W. Joyce, formerly roundhouse foreman on the Union Pacific at Sharon Springs, has been appointed master mechanic on the Peoria and Pekin & Union railroad, with office at Peoria, Ill.

Mr. W. A. Harlan has been appointed oil burning inspector on the Southern Pacific at Oakland Pier, Cal., and Mr. J. W. Ward has been appointed to a similar position on the same road at Portland, Ore.

Mr. R. B. Salmons has been appointed master mechanic of the Cincinnati terminals and Kentucky division of the Louisville & Nashville, with offices at Covington, Ky. He succeeds Mr. W. H. Dunlap, resigned.

Mr. H. H. Stephens has been appointed master mechanic on the Atchison, Topeka & Santa Fe, at Wellington, Kan. He succeeds Mr. H. Schaefer, who has been transferred to a similar position on the same road, at Clovis, N. M.

Mr. C. D. Porter, formerly assistant master mechanic on the Pennsylvania at Pittsburgh, Pa., has been appointed assistant to the general superintendent of mo-

tive power at Altoona, Pa. Mr. F. L. Robbins succeeds Mr. Porter at Pittsburgh.

Mr. W. E. Jenkinson has been appointed railroad representative for S. F. Bowser & Co., covering the territory vacated by Mr. E. F. G. Meisinger. In addition he will take over the Southwestern and Pacific Coast territory. He will cover the States from Texas to Oregon.

Mr. H. Montgomery has resigned as superintendent of motive power and equipment of the Bangor & Aroostook, and the position has been abolished, and Mr. R. Q. Prendergast has been appointed mechanical superintendent, with headquarters at Milo Junction, Me.

Mr. A. T. Shortt, formerly master mechanic of the Alberta division of the Canadian Pacific at Calgary, Alta., has been appointed superintendent of the Ogden shops, Calgary, and Mr. G. N. Whiteley, formerly district master mechanic at Moose Jaw, Sask., succeeds Mr. Shortt at Calgary.

Mr. P. D. Dunlop, formerly mechanical superintendent of the Gulf, Colorado & Santa Fe, has been appointed general superintendent of motive power of the St. Louis & San Francisco, with offices at Springfield, Mo. He succeeds Mr. G. A. Hancock, who has resigned on account of failing health.

Mr. G. O. Huckett has been appointed master mechanic on the Chicago, Burlington & Quincy, with office at Sterling, Colo. Mr. C. A. Henry has been appointed shop superintendent on the same road at West Burlington, Ia., and W. A. Barnes has been appointed road foreman of locomotives on the same road, with office at Ottumwa, Ia.

Mr. W. H. Scribner has been appointed supervisor of mechanical examinations of the Lake Shore, the Dunkirk, Allegheny Valley & Pittsburgh, the Chicago, Indiana & Southern, and the Indiana Harbor Belt, with offices at Cleveland, Ohio. He has charge of the examination of firemen for promotion, also general instruction of locomotive firemen.

Mr. W. H. Maddocks, assistant superintendent of motive power on the Missouri, Kansas & Texas, at Denison, Tex., has been transferred to Parsons, Kan., and Mr. J. Malsed, master mechanic on the same road at McAlester, Okla., has been transferred to Muskogee, Okla., and Mr. J. H. Henley, road foreman of engines on the same road at McAlester, has been transferred to Muskogee.

Mr. C. B. Daily has been appointed master mechanic on the Chicago, Rock Island & Pacific, with office at Cedar Rapids, Ia. He succeeds Mr. F. W. Williams, who has been transferred to Manly, Ia., and Mr. P. Linthicum succeeds Mr. Daily as assistant superintendent of the Silvis shops, and Mr. O. S. Beyer, Jr., succeeds Mr. Linthicum as general foreman of the shops at Horton, Kan.

Officers of General Foremen's Association.

At the annual convention of the International Railway General Foremen's Association, the proceedings of which are elsewhere reported in our columns, the election of officers resulted as follows:

W. W. SCOTT,
President, General Foremen's Association.

For president, Mr. W. W. Scott, general foreman, Delaware, Lackawanna & Western R. R., Buffalo, New York; first vice-president, Mr. T. F. Griffin, general foreman, Cleveland, Cincinnati, Chicago & St. Louis Ry., Indianapolis, Indiana; second vice-president, Mr. L. A. North, shop superintendent, Illinois Central Ry., Chicago, Illinois; third vice-president, Mr. Wm. Smith, assistant general foreman, Delaware & Hudson Company, Watervliet, New York; fourth vice-president, Mr. W. T. Gale, machine shop foreman, Chicago & North Western Ry., Chicago, Illinois, and secretary and treasurer, Mr. Wm. Hall, general foreman, Chicago & North Western Ry., Winona, Minnesota. Members of the executive committee for the ensuing year are Mr. C. L. Dickert, Central of Georgia Railway; Mr. J. F. Sheafe, Illinois Central Ry.; Mr. W. G. Ryer, Nashville, Chattanooga & St. Louis Ry.; Mr. G. H. Logan, Chicago & North Western Ry., and Mr. C. M. Newman, Atlantic Coast Line R. R.

WM. HALL,
Secretary-Treasurer, General Foremen's Association.

Committees of the Master Mechanic's Association.

Subjects for reports and committees selected for the 1914 convention:

STANDING COMMITTEES.

1. Revision of Standards and Recommended Practice. — W. E. Dunham (chairman), Supt. M. P. & M., C. & N. W. Railway, Winona, Minn.; R. B. Kendig, C. M. E., N. Y. C. Lines, New York City; M. H. Haig, M. E., A. T. & S. F. Railway, Topeka, Kan.; A. G. Trumbull, M. S., Erie R. R., Jersey City, N. J.; C. D. Young, Engr. Tests, Penna. R. R., Altoona, Pa.

2. Mechanical Stokers.—A. Kearney (chairman), A. S. M. P., N. & W. Railway, Roanoke, Va.; M. A. Kinney, S. M. P., Hocking Valley Railway, Columbus, Ohio; J. H. Tinker, S. M. P., Chicago & Eastern Illinois Railroad, Danville, Ill.; J. B. Thomas, S. M. P., Northern Central Railway, Williamsport, Pa.; J. T. Carroll, A. G. S. M. P., Baltimore & Ohio Railroad, Baltimore, Md.

SPECIAL COMMITTEES.

3. Safety Appliances.—D. R. MacBain (chairman), S. M. P., L. S. & M. S. Railway, Cleveland, Ohio; M. K. Barnum, general mechanical inspector, Baltimore & Ohio Railroad, Baltimore, Md; C. B. Young, engineer tests, Pennsylvania Railroad, Altoona, Pa.

4. Design, Construction and Inspection of Locomotive Boilers.—T. W. Demarest (chairman), S. M. P., Pennsylvania Lines, Ft. Wayne, Ind.; F. H. Clark, G. S. M. P., Baltimore & Ohio Railroad, Baltimore, Md.; Willard Kells, A. G. S. M. P., A. C. L. Railroad, Wilmington, N. C.; E. W. Pratt, A. S. M. P., C. & N. W. Railway, Chicago, Ill.; P. P. Mirtz, M. E., L. S. & M. S. Railway, Cleveland, Ohio; E. S. Fitzsimmons, M. S., Erie Railroad, Cleveland, Ohio; J. Snowden Bell, New York City.

5. Locomotive Headlights. — D. F. Crawford (chairman), G. S. M. P., Pennsylvania Lines, Pittsburgh, Pa.; A. R. Ayers, G. M. E., L. S. & M. S. Railway, Chicago, Ill.; C. H. Rae, G. M. M., L. & N. Railway, Louisville, Ky.; F. A. Torrey, G. S. M. P., C. B. & Q. Railroad, Chicago, Ill.; H. T. Bentley, P. A. S. M. P., C. & N. W. Railway, Chicago, Ill.; M. K. Barnum, G. M. I., Baltimore & Ohio Railroad, Baltimore, Md.; Henry Bartlett, G. M. S., B. & M. Railroad, Boston, Mass.

6. Standardization of Tinware.—M. D. Franey (chairman), M. M., L. S. & M. S. Railway, Elkhart, Ind.; J. C. Mengel, M. M., Pennsylvania Railroad, Altoona, Pa.; W. C. Hayes, S. L. O., Erie Railroad, New York City; J. A. Carney, S. S., C. B. & Q. Railroad, Aurora, Ill.; S. L. Bean, M. S.; A. T. & S. F. Railway, Los Angeles, Cal.

7. Use of Special Alloy and Heat Treated Steel in Locomotive Construction.—A. R. Ayers (chairman), G. M. E,. L. S. & M. S. Railway, Chicago, Ill.; W. F. Kiesel, Jr., A. M. E., Pennsylvania Railroad, Altoona, Pa.; F. O. Bunnell, Engr. Tests, C. R. I. & P. Railway, Chicago, Ill.; F. J. Cole, C. C. E., American Locomotive Co., Schenectady, N. Y.; S. M. Vauclain, vice-president, Baldwin Locomotive Works, Philadelphia, Pa.; J. C. Little, M. E., C. & N. W. Railway, Chicago, Ill.; M. F. Cox, M. E., L. & N. Railroad, Louisville, Ky.

8. Smoke Prevention.—E. W. Pratt (chairman), A. S. M. P., C. & N. W. Railway, Chicago, Ill.; J. F. DeVoy, A. S. M. P., C. M. & St. P. Railway, W. Milwaukee, Wis.; W. C. Hayes, S. L. O., Erie Railroad, New York City; T. R. Cook, A. E. M. P., Pennsylvania Lines, Pittsburgh, Pa.; Jos. Chidley, A. S. M. P., L. S. & M. S. Railway, Cleveland, Ohio; A. G. Kantmann, S. M., N. C. & St. L. Railway, Nashville, Tenn.; W. J. Tollerton, G. M. S., C. R. I. & P. Railway, Chicago, Ill.

9. Revision of Standard Efficiency Tests of Locomotives.—C. D. Young (chairman), Engr. Tests, Pennsylvania Railroad, Altoona, Pa.; W. H. Flynn, S M. P., Michigan Central Railroad, Detroit, Mich.; Prof. L. E. Endsley, Purdue University, Lafayette, Ind.; Prof. E. C. Schmidt, University of Illinois, Urbana, Ill.; J. A. Pilcher, M. E., N. & W. Railway, Roanoke, Va.

10. Revision of Air Brake and Train Signal Instructions. — R. B. Kendig (chairman), C. M. E., N. Y. C. Lines, New York City; R. K. Reading, S. M. P., Pennsylvania Railroad, Altoona, Pa.; B. P. Flory, S. M. P., N. Y. O. & W. Railway, Middletown, N. Y.; L. B. Streeter, Air Brake Inspector, Ill. Cent. Railroad, Chicago, Ill.; A. J. Cota, M. M., C. B. & Q. Railroad, Chicago, Ill.; T. L. Burton, Westinghouse Air Brake Co., Wilmerding, Pa.; W. J. Hartman, Air Brake Institute, C. R. I. & P. Railway, Chicago, Ill.

11. Superheater Locomotives.—J. T. Wallis (chairman), G. S. M. P., Pennsylvania Railroad, Altoona, Pa.; C. H. Hogan, A. S. M. P., N. Y. C. & H. R. Railroad, Albany, N. Y.; R. W. Bell, G. S. M. P., Ill. Cent. Railroad, Chicago, Ill.; T. Roope, S. M. P., C. B. & Q. Railroad, Lincoln, Neb.; W. J. Tollerton, G. M. S., C. R. I. & P. Railway, Chicago, Ill.; H. H. Vaughan, assistant to vice-president Canadian Pacific Railway, Montreal, Can.; J. R. Gould, S. M. P., C. & O. Railway, Richmond, Va.

12. Train Resistance and Tonnage Rating.—P. F. Smith, Jr. (chairman), S. M. P., Pennsylvania Lines, Toledo, Ohio; W. E. Dunham, Supt. M. P. & M., C. & N. W. Railway, Winona, Minn.; E. J. Searles, S. M. P., B. & O. Railroad, Pittsburgh, Pa.; H. C. Manchester, S. M. P., D. L. & W. Railroad, Scranton, Pa.; C. E. Chambers, S. M. P., C. R. R. of N. J., Jersey City, N. J.; J. H. Manning, S. M. P, D. & H. Co., Albany, N. Y.; Frank Zeleny, Engr. Tests, C. B. & Q. R. R., Aurora, Ill.

13. Statistics.—T. J. Burns, A. S. M. P., Mich. Cent. Railroad, Detroit, Mich.; John Purcell, assistant to vice-president, A. T. & S. F. Railway, Chicago, Ill.; O. C. Wright, A. E. M. P., Pennsylvania Lines, Pittsburgh, Pa.; W. H. Winterrowd, M. E., Can. Pac. Railway, Montreal, Can.; O. C. Cromwell, M. E., Baltimore & Ohio Railroad, Baltimore, Md.; E. M. Rhett, electrical engineer, C. of Ga. Railway, Savannah, Ga.; C. A. Brandt, M. E., C. C. C. & St. L. Railway, Beech Grove, Ind.

14. Fuel Economy. — Wm. Schlafge (chairman), G. M. S., Erie Railroad, New York City; W. H. Fetner, M. M., Cent. of Ga. Ry., Macon, Ga.; D. M. Perrine, S. M. P., Pennsylvania Railroad, New York City; G. A. Hancock, G. S. M. P., St. L. & S. F. Railroad, Springfield, Mo.; Robt. Quayle, S. M. P., C. & N. W. Railway, Chicago, Ill.; S. G. Thomson, S. M. P. & R. E., Phila. & Reading Railroad, Reading, Pa.; D. J. Redding, A. S. M. P., P. & L. E. Railroad, McKees Rocks, Pa.

15. Subjects.—A. W. Gibbs (chairman), C. M. E., Pennsylvania Railroad, Philadelphia, Pa.; C. F. Giles, S. M., L. & N. Railroad, Louisville, Ky.; C. E. Fuller, A. G. M., Union Pac. Railroad, Omaha, Neb.

16. Arrangements. — D. R. MacBain (chairman), L. S. & M. S. Railway, Cleveland, Ohio; M. K. Barnum, G. M. I., B. & O. Railroad, Baltimore, Md.; B. A. Hegeman, Jr., vice-president, U. S. Metal & Manufacturing Co., New York City.

INDIVIDUAL PAPERS.

1. "Dimensions for Flange and Screw Couplings for Injectors," by Mr. O. M. Foster, M. M., L. S. & M. S. Railway, Collinwood, Ohio.

2. "Motors for Railway Shops," by Mr. B. F. Kuhn, A. M. M., L. S. & M. S. Ry., Collinwood, Ohio.

3. "Review of the Work Done by Other Mechanical Organizations," by Dr. Angus Sinclair.

These committees will all make special reports at the meeting of the association next year, and an unusually interesting convention may be anticipated.

Howard Elliott, President, New York, New Haven & Hartford Railroad.

One of the most important railroad official changes lately made was the election of Mr. Howard Elliott to be president of New York, New Haven & Hartford Railroad in place of Mr. Mellen, resigned. Mr. Elliott, who is of Scots ancestry, was born in New York in 1860. He graduated from Harvard University in 1881 and entered railroad service in the engineering department of the Chicago, Burlington & Quincy, which he worked in for about one year. Then he went into the traffic department of the St. Louis, Keokuk & Northwestern Railroad, where he rose to be general freight and passenger agent. Then he was auditor and assistant treasurer of the Burlington & Kansas City lines, where he rose to be general manager. Next mile post of his career notes that he was vice-president of the Chicago, Burlington & Quincy, which position he left in 1903 to be president of the Northern Pacific Railway, and has just consented to become president of a railroad system with about 4,500 miles of track, 2,500 locomotives and 70,000 cars.

Jerome - Edwards Metallic Packing Company.

Mr. George C. Jerome, formerly of Jerome Metallic Packing Company, has consolidated the interests of the Jerome company with those of the D. H. C. Co. and Nathaniel Huggins—owners of the Edwards and Wisch patents, pertaining to and particularly designed for piston rods and valve stems of high pressure and superheat locomotives. The firm will hereafter be known as the Jerome-Edwards Metallic Packing Company, with main offices, as heretofore, in the Railway Exchange Building, Chicago. The company will specialize in the manufacture and sale of metallic packing for all classes of locomotives, as well as babbitt metals made to requirements or specifications.

Obituary.

L. C. NOBLE.

The many friends in railway and business circles of Mr. L. C. Noble, vice-president of the Pittsburgh Spring & Steel Company, will be pained to learn of his death at his home in Evanston, Ill., on Saturday, July 19, after a short illness. Mr. Noble was for many years superintendent of motive power of the Houston & Texas Central Railroad, prior to 1890. In that year he became associated with the A. French Spring Company as Western manager of sales. In 1902 he resigned to become vice-president of the Pittsburgh Spring & Steel Company, with offices in Chicago, which position he held at the time of his death.

RAILROAD NOTES.

The Norfolk & Western is said to be in the market for 10 locomotives.

The Union R. R. has ordered 296 50-ton gondolas from the Pressed Steel Car Co.

The Chicago & Eastern Illinois has received permission from the court to buy 4 locomotives.

The San Antonio & Aransas Pass, it is said, will soon be in the market for about 10 locomotives.

The Great Northern, it is reported, has ordered 1,000 coal cars from the American Car & Foundry Co.

The Intercolonial Railway, it is reported, has ordered 1,050 box cars and 225 various freight cars.

The Virginia & Southwestern has ordered three locomotives from the Baldwin Locomotive Works.

The Interurban is in the market for 10 60,000-lbs. capacity box cars and 25 80,000-lbs. capacity box cars.

The Southern Pacific is said to be contemplating the building of a roundhouse and shops at Springfield, Ore.

The Indiana Harbor Belt has ordered 8 six-wheel switching locomotives from the Baldwin Locomotive Works.

The Boston & Albany has ordered 6 Pacific locomotives and 14 mikado locomotives from the American Locomotive Co.

The Southern has ordered 15 mikado locomotives and 10 Pacific type locomotives from the Baldwin Locomotive Works.

The Bessemer & Lake Erie car and repair shops at Greenville, Pa., will be rebuilt at an expenditure of approximately $400,000.

The Pennsylvania has awarded a contract to the McClintic-Marshall Construction Co. for 1.200 tons of structural steel for track elevation work.

The Southern has ordered 25,000 to 30,000 tons of rails, of which it is understood about 18,000 will be rolled at Ensley, Ala., and the rest at Sparrows Point, Md.

The Boston & Albany is making inquiries for 40 all-steel coaches, 4 all-steel postal cars, 4 all-steel combination passenger and baggage cars and 2 all-steel dining cars.

A contract has been given to Henry Post, Woodstock, N. B., at $100,000 by the Canadian Pacific, it is reported, for putting up new concrete and steel shops at McAdam Junction, N. B.

The Chicago, Milwaukee & St. Paul is erecting a building, comprising an oil house, boiler house, engine house and tool room addition at Minneapolis, Minn., at a total expenditure of $40,000.

The Chicago, Burlington & Quincy has ordered one rotary snow plow, with 12 ft. cut scoop wheel, 18 x 26 in. cylinders, and driving wheels 33 ins. in diameter, from the American Locomotive Co.

The Seaboard Air Line is said to have ordered 100 tons of bridge steel from the Virginia Bridge & Iron Works, Roanoke, Va., and also 250 tons of steel for turntables and bridges from the Fort Pitt Bridge Works, Pittsburgh, Pa.

The Chilean State Rys. are said to be ready to negotiate the purchase of 100 locomotives, of which 80 will be broad gage and 20 narrow gage. The former will include 20 engines for passenger service, 50 for freight service and 10 switching locomotives.

The Canadian Pacific, it is reported, has awarded a contract to the J. S. Metcalfe Co., Ltd., Montreal, Que., and work is to be started at once, putting up stations and other structures on the new line between Glen Tay Junction, Ont., and Agincourt, which are 183 miles apart.

The general contract for the new machine shop and roundhouse for the Canadian Pacific at McAdam Junction has been let to Henry Post, of Woodstock, Ont. The building will be 151 feet long, 145 feet wide and 45 feet high, and will be of concrete and steel construction.

The Nigerian Railways of Africa have ordered 8 Mountain type locomotives from the America Locomotive Co. These locomotives will be equipped with superheaters and will have 18 in. by 23 in. cylinders and 42¾ in. driving wheels. In working order they will weigh 140,000 lbs.

The charter has been approved for the organization of the Gulf, Freeport & Northern Railway. It is reported that this company proposes to build and operate a standard steam gauge railroad from Freeport to Sealy, a distance of 100 miles. The general offices are to be located at Freeport, Tex.

Historical Notes on Smoke Prevention.

By Angus Sinclair.

Speaking on Smoke Prevention sends me away back into ancient history. When railways were first constructed in Great Britain, laws were enacted strictly prohibiting what is now known as the smoke nuisance. It was positively enacted that the engines must be operated without smoke, the consequence being that the companies had to fall back on using coke as fuel for their locomotives. In about twenty years of locomotive operation, it was found that coke was a very expensive fuel, and the more enterprising railways began to try what they could do with bituminous coal, which was cheap in the British Isles. One of the first moves in that direction was the invention of a smoke-preventing fire-box by D. Kinnear Clark, a well-known mechanical engineer, who is author of several well-known books on railway machinery and mechanics generally. He invented a fire-box with steam jets used to induce currents of air into the fire-box. That steam jet patent of Mr. Clark's has been imitated a great many times, and has been the foundation of a great many other smoke-preventing devices for locomotive fire-boxes which were patented in this country.

The jets were not found entirely satisfactory, although many of the locomotives in Britain were running and burning coal by the aid of steam jets, and a few years later, Thomas Yarrow, the locomotive superintendent of the Scottish Northeastern Railway, conceived the idea of applying a brick arch to the smoke box. He applied the brick arch to the fire-box and used the Clark jets in connection with it. That combination made as good a smoke-prevention device as was ever applied to a locomotive. That has been the most successful smoke-preventing arrangement that has ever been tried, and when it is properly used and properly applied, with the aid of a skilful fireman, there is no difficulty whatever in preventing smoke emission from locomotives.

The difficulty in this country I have found was that some of the roads would put these appliances in a fire-box and leave them there without any thought or attention whatever, but you can never successfully do anything in that particular line of improvement, without having the device given attention all the time by the firemen. A highly important matter is to instruct the fireman. Where carelessness exists, as it does in too many instances, there is no end of smoke.

I was in the office of the locomotive superintendent who invented the brick arch, as a young man, and had a good deal to do with making out records of smoke-prevention appliances, and therefore have known at first hand what they have accomplished. I fired and ran locomotives with that smoke-preventing fire-box, and when I came to the United States, the first thing that struck me was the wastefulness that was displayed in the combustion of coal through careless firing of locomotives. When wood was used for fuel in this country, there was no smoke-preventing problem; but when the railroads changed from wood to coal, the locomotive men were occupied mostly in methods for making the engines steam well when they were burning coal. For many years there was no attention whatever paid to the economy of fuel or the prevention of smoke. What was wanted were methods and appliances to make the engines steam.

When I ran a locomotive first in Iowa, the firemen on the road on which I was employed had no idea of smoke-prevention, even to the slightest degree. Their idea of firing was to throw in a dozen or so scoops of coal, and then climb up to the seat box and watch the smoke rolling from the smoke-stack, and as soon as the smoke began to lighten, they would get down and pitch in a lot more coal. They were firing the locomotives, with the amount of smoke as a guide.

I, as a man accustomed to the smokeless firing on the other side, remonstrated with them against that system, but they said that was the right way, and they did not mean to change their habits because a man from a foreign country came to talk about smoke-prevention.

I have been an aggressive apostle of smoke-prevention in the United States. I insisted on my firemen doing their work with as little smoke as they could have, and firing with the idea of getting steam with as little coal as could possibly be used. Some of them were very much opposed to it, but a few joined in heartily with my system, and after they got accustomed to understand real, proper firing, there was no difficulty with them.

Several years afterwards, when I had left the railway service and was publishing an engineering newspaper, the general superintendent of the road I had been on sent for me, saying that they had introduced my system of firing, had it in successful operation, and they would like if I would come out there and watch how well they were doing, how well they could fire the locomotives without smoke. I went there and spent a week watching the operation of the engines on all sorts of trains, and they certainly were doing the work very successfully, for there was no smoke from the engines to speak of. Under certain circumstances, it is impossible to prevent smoke, but under ordinary circumstances they ran the engines successfully and smokelessly. Considerable improvement has been made since, and it is gratifying to observe that all are now interested in smoke-preventing devices.

Books, Bulletins, Catalogues, Etc.

Safety.

William H. Tolman, director of the American Museum of Safety, and L. B. Kendall have prepared an exhaustive work of over 400 pages, descriptive of safety methods for preventing occupational and other accidents and diseases. The book is published by Harper & Brothers, New York, and is in every way the most important work yet published on this vital subject. It is a handbook of practical information for every one interested in industry. Typical examples are on every page. Illustrations showing methods of safeguards are profusely used. The book clearly proves that 50 per cent. of all accidents could be avoided. The sanctity of life is a lesson that America has not fully learned, and the work before us is a noble effort in the right direction. The price of the book is $3.

Case-Hardening.

The Ideal Case-Hardening Compound Company, United States Rubber Company Building, New York, has just issued the fifth edition of an excellent pamphlet of thirty-six pages on Case-Hardening and Heat Treating of Steel. The work contains much useful information and practical rules, which are the result of extensive experience. There is much valuable new matter added, and those having copies of the older editions should secure a copy of the new edition, as the present edition is practically a new book. The book is for free distribution, and all who are interested in case-hardening should promptly secure a copy.

Rolled Steel Wheels.

The Standard Steel Works Company, Philadelphia, Pa., has issued a new catalogue on rolled steel wheels. An interesting feature is the application of a number to each wheel which number covers all standard dimensions except the bore. The process of manufacture is fully described with many detail illustrations. The standard sized axles for steam and electric service are also shown. Its compilation shows it is printed to enable easy and accurate purchasing. Tables and standard specifications are given, and numerous illustrations furnish a complete catalogue of car wheels. A section is also devoted to Standard tender and car axles showing specifications adopted by the Master Car Builders' and Master Mechanics' Associations, and also details in regard to Standard motor axles adopted by the American Electric Railway Association. Copies of the catalogue may be had on application.

Mikados vs. Consolidations.

A very interesting Bulletin, published by the American Locomotive Company, gives a mass of details showing comparisons between the performances of Mikado and Consolidation locomotives on no less than twenty-three of the leading railroads in America. The results in every case show that the Mikado type of locomotive, with opportunities for a fire box and boiler of large capacity, coupled with a high temperature superheater and fire brick arch, secures a maximum amount of power per unit of fuel consumed. With this boiler combine larger drivers and an increased cylinder diameter, and we have a locomotive which, when compared with the Consolidation, gives an increase in power at high rates of speed far greater in proportion than the increase in weight. Copies of Bulletin No. 1,013 may be had on application to the company's office, 30 Church street, New York.

Wrenches.

Armstrong Brothers Tool Company's Catalog No. 2, is just out, giving 32 pages of descriptive matter and illustrations in regard to their wrenches. Their products are so well known that little can be added to the high praise bestowed upon them by the mechanical world generally and the railroads particularly. Perhaps the most remarkable feature is the price lists which are tariff-defying and are really lower than anything else that we have ever seen. Send for a copy of the catalog and be convinced.

Staybolts.

Among the list of periodical publications "Staybolts," issued by the Flannery Bolt Company, Pittsburgh, Pa., appears with toned illustrations and terse descriptive matter. That the Tate flexible staybolt and adjustable crown stay are generally recognized as reliable standards of practical value is undeniable. Their rapidly increasing use in locomotive boiler construction is a proof of their utility. Speaking on the subject at the New York Railroad Club in May, 1910, Dr. Angus Sinclair said: "The engineering world has striven for 80 years to restrain the expansive forces of metal. They tried to resist the irresistible and to do so they made their sheets and staybolts heavier and heavier. There is an engineering aphorism that when an article breaks it is too weak; but that does not apply to staybolts and side sheets of boilers, for the heavier you make them and the harder you make them the more liable they are to break; and it seems now that the only remedy is to give flexibility instead of rigidity to these parts. This is a lesson

to the whole railroad world—to be prepared to give flexibility instead of stability. I think, gentlemen, it is going to be one of the most important movements that has ever happened in the railroad world, and is going to save untold trouble from leaky fireboxes and the terrific expense of continuously renewing a thing that appears to be just right and goes to destruction apparently as soon as the work is done."

Baldwin's Record No. 75.

Record No. 75, issued from the Baldwin Locomotive Works, is an elegant forty-page booklet showing fine illustrations with descriptive matter and dimensions of eighteen Mikado type locomotives as furnished by the Baldwin works for various railroad companies. The illustrations are excellent, while the descriptive matter contains much that is of real value to all who are interested in locomotive construction and performance. The high popular favor with which the Mikado type of locomotive is rapidly coming makes the publication of more than usual interest. It is not only comprehensive but timely.

Safety Hints.

The Pennsylvania Railroad Company has just issued a thirty-page pamphlet, of which 100,000 copies are being printed and distributed among the employees of the railroad, containing safety hints and suggestions for the prevention of personal injury accidents. The work is a model of its kind, and it is to be hoped that all railroads will follow the admirable example. Safety in railroad operation is not a question of safeguards, but of intelligent caution constantly exercised. The ultimate aim of the safety work is to develop in each employee a sense of personal responsibility, not alone in taking measures for his own safety, but for that of his fellow employee as well. Accidents should be as infrequent as human foresight can secure.

Pneumatic Tools.

The Chicago Pneumatic Tool Company issue monthly bulletins of much interest presenting as they do excellent descriptions of their fine products including portable air drills, midget little giant drills, geared and compound drills, wood boring machines, Boyer piston, and Keller rotary drills, and also their pneumatic grinders. The latter class of machines shows the advantages of portability possessed by pneumatic tools in a greater degree, perhaps, than any other device made. In grinding off flush rivets, slots in links, and similar work, it is rapid and effective. Copies of the illustrated bulletin may be had on application

Hancock Locomotive Inspirators.

A second edition of a Manual of Hancock Locomotive Inspirators is issued by the Hancock Inspirator Company. It extends to sixty pages and presents complete details of the various types of inspirators and directions for testing and repairing them. Although the principle and general construction of all Hancock lifting inspirators is the same, their capacities are varied. One standard body may be furnished in seven capacities of from 2,500 to 5,500 gallons per hour by the insertion of different interchangeable sets of tubes. Price lists of the various parts are also given, and all interested may secure copies of the Manual on application at the company's offices, 89 Liberty street, New York.

Resuscitation.

From electric shock, traumatic shock, drowning, asphyxiation from any cause. By means of artificial respiration by the prone pressure method. With anatomical details of the method and complete directions for self-instruction. By Charles A. Lauffer, A. M., M. D.

We have received from the Westinghouse Electric & Manufacturing Co., East Pittsburgh, a copy of this useful book, which ought to be within reach of every person connected with the operation of electrical appliances. The descriptive caption tells plainly the kind of information to be found in the book, which is a small volume convenient for carrying in the pocket. The descriptions of the operations necessary to save life are very plain and they are aided by good illustrations of the human anatomy. No price for the book was mentioned, but we think that the Westinghouse Electric & Manufacturing Co. would send a copy to any friend applying for it.

Manning, Maxwell & Moore, Inc., of New York City, together with their subsidiary companies, will move their general offices on or about October 1st from 85-89 Liberty street to the new Lewisohn Building, 113-119 West 40th street (near Broadway and running through to 114-118 West 41st street). They require a larger space to handle material increases in their various lines, which cover Electric Travelling Cranes, Machine Tools, Engineering Specialties, Railway, Machinists', Engineers', Factory and Contractors' Supplies. A large portion of this product is manufactured by their constituent companies, The Shaw Electric Crane Co., The Ashcroft Manufacturing Co., The Consolidated Safety Valve Co., The Hayden & Derby Mfg. Co. and the Hancock Inspirator Co. They will occupy the twentieth and twenty-first floors of the above building, which will give them 28,000 square feet of space.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVI. 114 Liberty Street, New York, September, 1913. No. 9

On the Norfolk & Western Railway

The rapid growth of the Norfolk & Western Railway since its reorganization in 1896 has been a matter of favorable comment among railroad men generally, and the development of the rich country through which the road passes is the best proof that a strong, well-managed organization is better calculated to become a miles, the most important of the branches being that from Portsmouth to Cincinnati, O. Apart from the main line, however, and of growing importance is the line running from Hagerstown, Pa., to Winston-Salem, North Carolina, and which crosses the main line at Roanoke, Va. Of the dozen or more railroads now amounting to 43,974. In recent years the passenger traffic has been increasing rapidly and 250 passenger cars of the most recent construction are in constant service, 26 of which are of the combination type, with additional 10 cars of the most approved dining type. Of mail and express cars there are 133, and recently

CROSSING THE ALLEGHENY MOUNTAINS ON THE NORFOLK & WESTERN RAILWAY.

matter of profit to the stockholders and also afford better service to the general public than a dozen of scattered branches of railroads with limited facilities and limited patronage. The main line reaching from Lambert's Point, Norfolk, Va., to Columbus, Ohio, is 702 miles in length, with branches and spurs extending to 250 owned or operated by the company the greater part are now double tracked, while the equipment is rapidly taking its place in the front rank of American railroads.

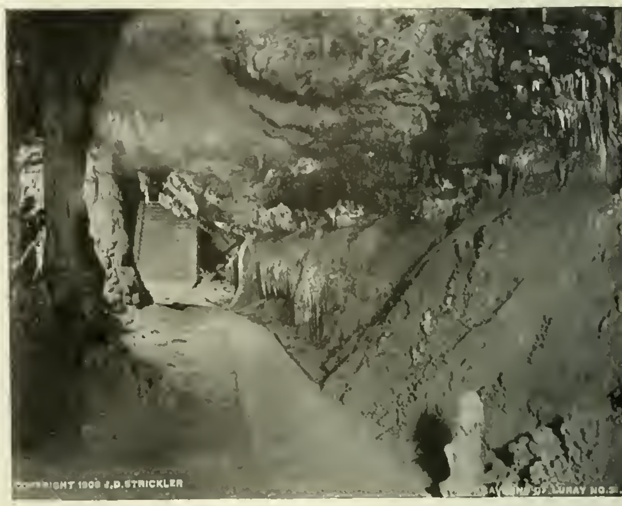
There are now over 2,000 miles of track in operation, with 1,030 locomotives in service, with a total number of cars an instruction car has been added which will be followed by others, so that generally speaking the rolling stock is being kept abreast of the requirements of the service.

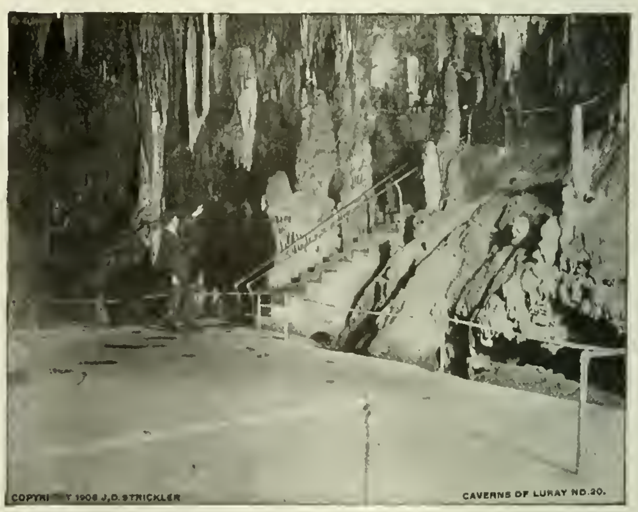
The principal shops for the general repairs of locomotives and cars are located at Roanoke, Va., with additional extensive

shops at Bluefield, W. Va., and at Portsmouth, O. Mr. W. H. Lewis, the superintendent of motive power has recently largely increased the shop facilities by introducing many machines of the electrically driven type, and his efforts are being ably sustained by his accomplished assistants.

It may be noted that in recent years there has been a marked increase in the passenger or tourist traffic. This is not to be wondered at as much of the railway passes through scenery of great natural beauty and historical interest. Among the most remarkable scenic phenomena is the Natural Bridge. This wonderful structure overlooks the James River Valley, being on the western slope of the Blue Ridge Mountains and near the center of the State of Virginia. It ranks among the great wonders of the world. It approaches Niagara in grandeur, and exceeds it in height and awful mystery. It is a single block of limestone, with many shades of color, wide enough to span Broadway and high enough to throw in shadow the turrets of Trinity Church. Under it "men look like boys, and trees like bushes."

NATURAL BRIDGE, VIRGINIA.





SCENES IN THE CAVERNS OF LURAY.

The visitor follows a tumbling cascade down a deep fissure in the mountain, under some of the largest arbor-vitæ trees in the world, and turning down a line of steps cut in the precipice suddenly finds himself by a swift stream in a dark canyon and the great bridge far above him. The height of the arch is 215 feet, width, 100 feet, span, 90 feet. It is distant from Washington, 200 miles, from Richmond, 180 miles, and from Cincinnati, 440 miles.

In the same locality and equally amazing are the Luray Caverns and the Grottoes of Shenandoah. They are located in the Shenandoah Valley of Virginia, the Luray Caverns being furthest north, being about 100 miles southwest from Washington. The Grottoes are 41 miles south of Luray Caverns, and the Natural Bridge is 69 miles south of the Grottoes. The united testimony of all who have explored the caverns is that they excel anything of their kind in the world in their extent, variety, scientific interest, and rare beauty of their wonderful calcite formation. In these strange caverns cement walks have been laid, and stairways and even bridges, and the entire route is illuminated by brilliant electric lights. The most amazing feature of the marvellous caverns is the imitation of nature and architecture in their richest variety suggesting not only rich tracery and drapery, but animal life and sometimes shapes of human beings. The scenes are altogether wonderful. The color is generally pearly white and cream illumined with an iridescence resembling myriad rainbow flashes of exquisite brilliance.

Among the grottoes Weyer's cave is perhaps the most remarkable. Here are wide galleries with foaming cataracts of stalactite, like water stiffened by sudden frost, and fluted columns of stone studded with rare gems. Further on are palaces and armories, and weird coral formations, and monumental columns; but it would be impossible to describe even briefly the myriad marvels of this region traversed by the Norfolk & Western Railroad, and visited by thousands of intensely interested tourists.

Safety Exhibit Car on the New York Central Lines

A new and extremely interesting feature of railroad enterprise and progressiveness has just been introduced by the New York Central Lines. At the Grand Central Terminal that company opened for inspection last month for the first time its Safety Exhibit Car, which has been put into service in connection with the work of the safety department of the company. The car is intended primarily to use as an instruction car, for the purpose of inculcating the doctrine of "Safety First" in the minds of 125,000 or more employees of the railroad. But it is an interesting exhibit to the layman, and many who are not employed on the road are expected to take advantage of the invitation extended by the officials of the Central to the public to inspect the car.

EXTERIOR VIEW OF SAFETY EXHIBIT CAR.

The interior of the car is finished in white enamel and looks as spick and span as a millionaire's yacht. Along both sides of the car is a shelf about three feet from the floor finished in mahogany, which contains models of every kind of machine used in the many shops on the system. The company requires all machines to be properly guarded so as to prevent workmen becoming caught in the various parts and injured. These models show the proper manner of applying these guards. The models of machines are perfect in detail and show at a glance how to make the machines safe.

Along the side walls of the car above the models are several rows of pictures, some of them showing machine guards, and various safety appliances. These pictures are neatly framed and form an interesting and instructive feature of the exhibit. On one side of the car the picture space is devoted entirely to unsafe practices, and there are fully a hundred photographs which explain graphically the common practices of railroad employees that cause accidents resulting in injuries to themselves and others. Alongside of a picture showing the improper or unsafe way of doing a certain kind of work, is another picture showing the safe or proper way. Employees will be taken through this car by an attendant and instructed in the matter of safeguarding, not only themselves, but the public from injury.

One section of the picture gallery is devoted to the trespass question and there are a number of pictures showing how persons risk their lives needlessly trespassing on railroad property. Above these trespass pictures is a statement calling attention to the fact that more than ten thousand trespassers are killed and injured annually on railroads in the United States.

At one end of the car is a stateroom and toilet for use of the attendant, who will accompany the car over the entire system of the road. Attached to the Exhibit Car there will be a coach which will be used as a lecture car. This car is equipped with a stereopticon and illustrated lectures on Safety will be given to employees at various points.

The New York Central Lines have a department devoted entirely to safety work and a systematic effort to bring about a reduction of all classes of accidents has been made for some time past. That the work is proving successful is indicated in a statement appearing in a frame in the car, showing that on the New York Central & Hudson River and Lake Shore and Michigan Southern, two of the N. Y. C. Lines, there were 35 fewer employees killed on duty in only four months after the safety work was inaugurated.

INTERIOR OF SAFETY EXHIBIT CAR.

Cost of Stopping a Train.

According to Signal Engineer J. A. Peabody, of the Chicago and Northwestern Railway, who investigated the matter on his own line, the cost of stopping a train of 530 tons and returning to a speed of fifty miles an hour is 42 cents. The cost of stopping a 2,000-ton train from thirty-five miles an hour is $1. The officials of another road estimate each stop of a six-car passenger train from forty-five miles an hour at 35 cents, and for a 1,500-ton train from fifteen miles an hour at 56 cents. The time that is lost for making a stop on a level straight track has been estimated at 145 seconds by careful engineers.

General Correspondence

Old Scheme.

Editor:

Without desiring to dampen the enthusiasm of your correspondent, Dr. Leonard Keene Hirschberg, or disparage the mechanical ability of Prof. Stumpf, I call attention to the fact that Dr. Hirschberg is wholly in error in his statement that the "newly operated locomotive" to which he refers, in which "the exhaust openings are in the middle section of the cylinder," is "a valuable and startling innovation in locomotive construction."

As a matter of fact the "central exhaust" or "una-flow" cylinder is an old design, and an American invention, patented here as early as 1857, and successfully operated in railroad service in 1875. It is shown in the U. S. Patents of B. Eaton, No. 17147, April 28, 1857; J M. Hirlinger, No. 70841, November 12, 1867; and Shepherd & Clark, No. 124,980, March 26, 1872, copies of which can be obtained from the Commissioner of Patents, Washington, D. C., at a cost of five cents each.

In 1875, a locomotive having "central exhaust" cylinders was built from the designs of Col. E. A. L. Roberts, by the Brooks Locomotive Works, of Dunkirk, N. Y., and was put in service, with entirely satisfactory results, on the Dunkirk, Allegheny Valley & Pittsburgh R. R. The design was probably ahead of the times, and some time after 1880, ordinary cylinders were substituted. About 1894, the "central exhaust" cylinder reappeared and was claimed as a novelty under the name of the "Cleveland" cylinder. It was applied on a 16 x 24 locomotive of the Intercolonial Railway.

In view of the above, it will be obvious that no claim of originality or "startling innovation" in the central exhaust or "una-flow" cylinder can be maintained by Prof. Stumpf.

J. Snowden Bell.

New York, N. Y.

Turn-Table Device.

Editor:

Occasional trouble arises on turn-tables, especially of the air-driven variety, when the motor breaks down, and the accompanying sketch shows a simple device whereby the turn-table may be moved by hand until the motor is ready for service again. It will be noted that two brackets are placed to the turn-table guard-rail in the manner and distance apart as shown in the sketch. A turning arm may be readily placed in the brackets, one of the ends of the turning arm being adapted to fit in the smaller bracket and held in place by a movable pin. With a suitable length of turning bar two men may readily move the turning table. When the motor is in service the hand bar and brackets may be removed to a suitable resting place. It will be observed that the brackets are constructed so as to slide easily on the T-shaped plates as shown.

J. G. Koppell.

Montreal, Canada.

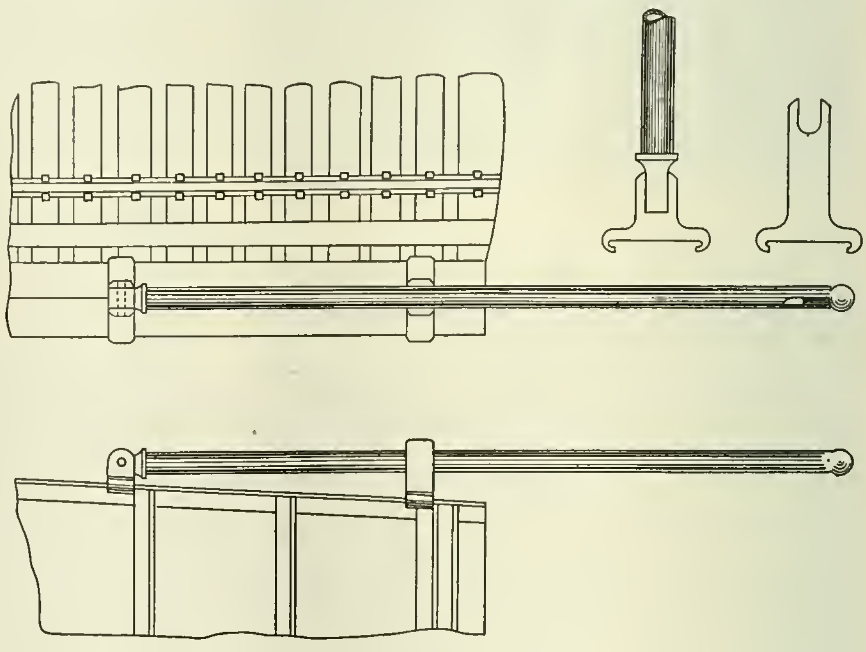
Light and Loaded Car Brake Adjuster.

Editor:

The method of obtaining increased braking power on loaded cars suggested in Mr. Bellhouse's letter on page 126 of your issue of April, 1913, appears quite simple from the illustrations and description given, but like many other arrangements which are simple in principle, the application is by no means so free from complication. This is not a mechanical problem solely, as seems to be supposed. The multiplication of the cylinder force by means of the foundation brake rigging is so related to and dependent upon other vital factors pertaining to the proper operation of the brake system for a given car that the combination is intricate and must conform to certain well established fundamentals of brake design. The relations between the size of the brake cylinder; the multiplication of force afforded by the brake rigging; the piston travel and the brake shoe clearance, are in reality adjusted to such a perfect working balance in the standard brake installation that the introduction of any new factors or a change in any of the existing factors, not in complete harmony with the existing relations, disarranges the whole combination.

Aside from any consideration of the mechanical application of such a scheme as suggested, suppose that an ideal arrangement of apparatus could be applied to the ordinary freight car as explained in the article referred to and see what results.

Assume an empty car to weigh 35,000 lbs. The standard nominal braking power of 60 per cent. of its light weight would be obtained with an 8-in. brake cylinder with about 8.4 to 1 total leverage ratio.



TURN-TABLE DEVICE.

Assuming that the car has a capacity of 100,000 lbs. with 10 per cent. overload capacity, the nominal percentage of braking power with the standard brake arrangement on such a fully loaded car would be 14.5 per cent. Increasing the total leverage ratio to 12 to 1 by the method suggested by your correspondent would increase this percentage of braking power to only 21 per cent.

This gain in percentage of braking power is not only insignificant, but it is secured at the expense of an increase in

total leverage ratio above 9 to 1 which, as proved by long experience, is impracticable, considering the circumstances and requirements of general service operation.

But this is not all. It is fair to assume that with the standard brake arrangement the shoe clearance was proper and satisfactory and that the standard piston travel of 8 ins. was approximated sufficiently closely to insure proper results being obtained from the air brake mechanism. It must be remembered that the operation of the air brake becomes unsatisfactory in proportion as the piston travel varies from the 8 ins. adopted as standard. Now if the total leverage ratio is increased from 8.4 to 1 up to 12 to 1, as in the case assumed above, the piston travel would increase, other things remaining equal, from 8 ins. to 11½ ins., which would destroy the effect of the brake. On the other hand if the piston travel is still held down to 8 ins. the shoe clearance will be only ¾ of its former value. What actually happens in such a case is that the piston travel and shoe clearance required for satisfactory operation would be so altered that the proper operation of the brake would be impossible.

That is to say, in increasing the percentage of braking power on the loaded car but a relatively small amount (from 14.5 per cent. to 21 per cent.) we would have to shoulder the various annoyances and expense which cannot be avoided when there is insufficient shoe clearance, too high a total leverage ratio, or incorrect piston travel. At the same time the braking power on the loaded car is still far short of that on the empty car (60 per cent.).

The fundamental relations referred to explain why it has never been possible to work out in a practicable and serviceable form any of the multitude of devices and arrangements of rigging that have been suggested periodically for years past, by which it is proposed to increase the braking power on the loaded car by a change in total leverage ratio alone.

The situation is not hopeless, however, and it is proper to record the fact that hundreds of cars equipped with a practicable empty and load brake arrangement, involving no departure from the fundamental requirements of proper air brake design and installation, are giving regular and highly satisfactory service on several railroads. S. W. Dudley.

Pittsburgh, Pa.

Device for Transferring Grain from Bad Order Cars by Compressed Air.

Editor:

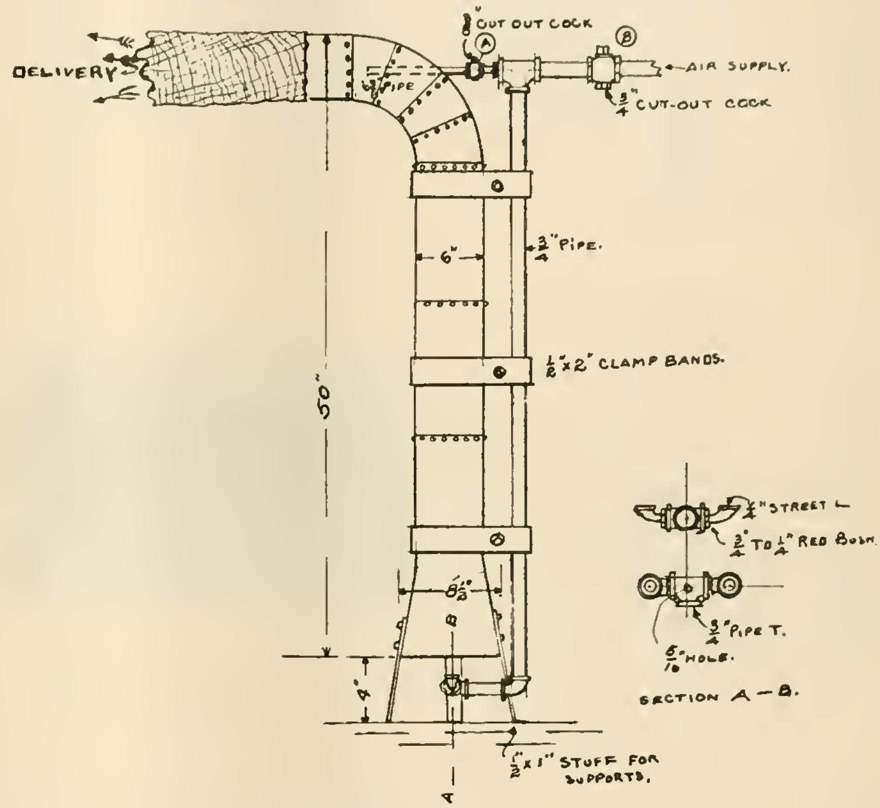
There have been a great many devices and methods tried in connection with the transfer of grain from bad order cars unable to take or continue on the road. The enclosed sketch is descriptive of a device that the author has found very practical where compressed air is available.

The body of the arrangement is of ⅛ in. sheet iron supported by three legs the size and number of which can be varied to suit the individual maker. The delivery of the grain is governed by the ⅜-in. cut-out cock A, while the lift is controlled by the larger cut-out B.

The time for emptying a car of course depends on the nature of the grain, but the measurements shown in above sketch were found by the writer to be well adapted for transferring all light grains whose movement in shipment was checked by failure of the car. Supplied with an unbroken flow of air from 90 to 100 lbs., the device in operation can excel the labor of from at least five to six men.

F. W. Bentley, Jr.,
C. & N. W. Ry.

Milwaukee, Wis.



GRAIN TRANSFER DEVICE.

Taking Up the Slack.

Editor:

We often see an engineer having great difficulty in starting a long freight on a grade or even failing to do so. He tries to take up slack but frequently before he can get the lever over, the slack has all run out on account of the grade.

Here is an easy way if the locomotive has the E. T. equipment or straight air brake. First get the train moving backward, reversing if necessary, but the lever must be again in forward gear before the next step is taken. Then graduate the locomotive brakes on, release just before the train comes to a stop and open throttle the proper amount to start the train. Stopping in this fashion will stretch the train, so that when it comes to rest, a good many of the rear cars will surge forward and thus decrease the dead weight to be started by the engine. In this way the whole train will be put in motion simultaneously. Of course, care must be taken in applying the locomotive brakes especially if the slack is momentarily bunched at the head end. Otherwise a drawbar may be pulled.

William G. Landon.

New York, N. Y.

Fireboxes and Tube Plates.

Editor:

Can any of the readers of Railway and Locomotive Engineering tell why the railroads do not adopt the Wood fireboxes and tube plates? It would be a great satisfaction to have some explanation, inasmuch as the records printed of some two or three boilers working on the New York Central & Hudson River Railroad prove the new firebox and tube plates to be better than the average in every way. I am informed that nearly all the colleges are very much interested and have the literature in regard to it on file. And I do not understand why, since the outside world has taken so much interest in it, the railroads have not adopted it. The corrugated construction which lends additional strength to the

boiler is now being very generally used in mechanical work.

The tabulated reports of a dynamometer test by the New York Central officials, which I was interested enough to go over and which are open to all who wish to see them, are proof that this new form of firebox far surpasses the old. I am not an engineer, but I have heard good engineers confirm the conclusions arrived at by Mr. John W. Harkom, of Melbourne, Quebec, that the principle is surely correct, therefore I would like to ask, why has it not been adopted by the railroads? It is eight times stronger than those at present used, and saves expenses in fuel and repairs. Is not this what the railroads want? If there are any technical objections they ought to be brought out. The railroads' neglect to adopt the new firebox in absence of practical objection should be overcome by law. And its use should be required the same as the Westinghouse Air Brake and other safety appliances.

Can some one answer me?

Henry C. Saulnier.

Philadelphia, Pa.

Old McKeesport Locomotive.

Editor:

Very few of the residents of McKeesport, Pa., know that their town long ago boasted of a locomotive works, nevertheless the accompanying illustration is reproduced from a photograph of a little locomotive which was built in that town at shops which at one time did a very extensive and diversified business, but which has long ceased to exist; indeed, few of the present inhabitants can point out the site once occupied by the buildings.

From the name of the engine painted in the panel of its cab, "Ellrod," I believe it was built for and used by a coal company at Ellrod Station, a short distance above McKeesport on what was the Pittsburgh & Connellsville R. R., but which is now the Pittsburgh Division af the Baltimore & Ohio.

Much to my regret I possess no dimensions of the engine, but the following will not be far from correct: Cylinders, 7 ins. x 14 ins.; drivers, 30 ins.; weight, about five or six tons; gauge, 39 ins. or 40 ins. Fuel, bituminous coal; boiler between 25 ins. or 30 ins. diameter.

Chilled driving wheels of plate pattern are shown in the illustration. The valve gear was the hook motion of the "drop hook" type.

Whether the firm built more locomotives, I cannot state, but in 1891 I saw either this engine or one exactly like it, lying with other scrap on the Allegheny River wharf at Pittsburgh.

All parts of this engine and its boiler except the brass fittings, were actually made in the McKeesport plant.

As will be noted from the illustration, the engine was built to haul trains of small coal cars on the narrow gauge tracks used at the bituminous coal mines of the Pittsburgh district. These wagons were constructed to carry a load of coal weighing 2,600 lbs., though at some of the mines larger sizes were used. The wheels were 16 ins. in diameter and turned on fixed axles like the wheels of a common wagon. This was on account of the sharp curves around which they were obliged to pass in going to and from the "rooms" of the collieries in which the miners worked. While the writer was connected with the Westmoreland Coal Co., at Irwin, Pa., arrangements were made with the Pennsylvania R. R. Co. for supplying the tenders of the locomotives with coal directly from these wagons as they came from the mines at the Spring Hill colliery of our company, about fourteen miles east of Pittsburgh.

C. H. Caruthers.

Yeadon, Pa.

McKEESPORT, PA., LOCOMOTIVE.

Old Time Railroad Reminiscences.

By S. J. Kidder.

Editor:

I believe the average American citizen is supposed to be honest, but when that individual sees an apparent opportunity to extort money from the treasury of a railroad company it is indeed surprising to what extent scruples will be sacrificed to permit the taking advantage of what promises to attain that end. Does the average passenger permit himself to believe he is departing from Webster's definition of honesty when ensconced behind a newspaper for instance, he manages to be overlooked by the conductor when that official is collecting fares and does he not carefully preserve the ticket for another passage, or again the man who enters a trumped up charge and institutes a lawsuit against the railroad and with the testimony of himself and neighbors endeavors to establish his case when, as a matter of fact, those other than himself know little or nothing of the culpability of the defendant, the one thought seemingly being anything to beat the railroad.

During my years of experience as a locomotive engineer numerous instances came under my observation and in some of which I participated, of suits brought against the company three of which I will relate and which illustrate some of the devious methods resorted to in an endeavor to extort money from the railroad company. The first case was that of Jacob Brandt who had sued the company for the burning of a twenty-ton hay stack, it being alleged that, on a certain Sunday evening, the stack had been set on fire by sparks from the locomotive pulling train No. 2, which was due to pass his place at 10.40 p. m. Brandt, to judge from his home surroundings, was what might be termed a shiftless farmer, as his house, outbuildings, fences, etc., had an appearance of neglect and decay and with his farming tools promiscuously scattered about the fields everything indicated that the owner largely left things to the care of nature's erratic elements. Jacob's farm was situated about one mile from the foot of White Breast, a one and a third per cent. grade, some three miles in length, the house and hay stack being perhaps seventy yards to the south of the track. Among the claims made by Brandt was that a party of friends was visiting him on the night in question and immediately following the passing of the train the hay stack was enveloped in flames and totally destroyed. One after another Jacob and his friends took the witness stand and testified of their presence, of seeing the train pass at 10.40, that the locomotive was emitting sparks freely—which was always the case at that particular place when hauling a heavy train and a number of witnesses went so far as to allege that they saw the sparks alight on the hay stack and start the fire. In those days there were no Sunday trains over White Breast from early in the morning until No. 2 at 10.40 p. m., making it impossible to confuse this train with any other. Following the direct testimony these witnesses were subjected to a sharp cross-examination, the main point of the railroad attorneys being to get them on record as to the precise time the train passed but no amount of questioning could prevail upon any of them to concede that the time was anything other than 10.40 p. m. Following the testimony of the Brandt faction the railroad lawyers produced evidence that the Brandt homestead had been the scene of gay festivities on that particular Sunday night, largely the result of a two-gallon jug of "Red Eye," the contents of which had been dispensed among the convivial guests, and that the participants were in such condition before the affair was over as to see things in a light quite contrary to that of normal vision.. The time ele-

ment proved a fatal one for Brandt as the railroad had no trouble in showing by the testimony of the other train men and myself, as well as the train sheet of the train dispatcher, that no train had passed the grade for some sixteen hours prior to the passage of No. 2 and that on the night in question this train was two hours late, passing White Breast twenty minutes after the midnight hour. This proof of perjury on the part of Brandt and others left little argument for his attorney and a verdict for the railroad was promptly rendered. The second incident occurred on the Keokuk branch, a few miles south of Burlington, Iowa. In addition to the C. B. & Q. trains those of the then Burlington & Southwestern railroad used the track from Burlington to Vielle, some twenty-five miles.

Upon their departure from Burlington the morning passenger trains of both roads were composed of three cars, the C. B. & Q. cars being painted yellow while those of the Southwestern were a severe black. The Southwestern train was due to leave at 7.40, the C. B. & Q. twenty minutes later and as the trains, with rare exceptions, departed on time the black cars went ahead, the yellow ones following. On the morning in question something happened to delay the departure of the Southwestern train, and as a result I pulled out on schedule time, the Southwestern following some twenty minutes later and forty minutes behind its regular time. At a point several miles below Burlington on a long straight piece of track was a highway crossing, the approaches to it from either side being obscured by weeds and bushes several feet in height, which grew in great profusion along the right of way, and to an extent that animals approaching the crossing could not be seen from the engine until they were within not more than a half dozen feet of the track. As the 2.45 approached the crossing, at a speed of perhaps forty-five miles an hour, a large, healthy-looking cow stepped from behind the brush onto the track and took a stand facing in the direction the train was moving, then turned her head as if to watch our approach. We were so near the crossing when the bovine took possession that to stop or materially slow down was impossible and as I always believed in hitting large animals hard, if at all, as a matter of safety to the train, the engine was not disturbed by either shutting off steam or applying the brakes, I meanwhile blowing a warning whistle. All this happened in a few short moments, and as the bumper beam came in contact with the hindquarters of that cow she suddenly became a sort of areoplane, swiftly flying at a slight angle from the track and the last of her to be seen was as she mowed down the weeds and brush preparatory to alighting.

To the owner it evidently appeared that here was a favorable opportunity to collect damages for the cow and he would perhaps have had little trouble in doing so had he simply stated the facts and played fair with the company actually involved. Instead he sued the South-Western Railroad and at the trial, as was done in the former case, brought several of his neighbors as witnesses, not one of which could see the crossing from their homes. The witnesses were a unit in testifying that they happened to be in the vicinity of the crossing when the accident happened, that they saw the engine hit the cow, that no whistle was sounded or bell rang, that the hour was the time when the first train always passed and that there was no question about its being the South-Western train, as all the cars were painted black. Up to this point the defendant appeared to have decidedly the worst of it, but when ample proof was presented by the railroad that their train was forty minutes late that morning and that it was a C. B. & Q. engine with a train of yellow cars that caused the cow to be summarily removed from her former activities the case was thrown out of court.

The third incident was that of another shiftless farmer who resided in a log shack several miles west of Fairfield and some twenty rods from a highway crossing. As we approached the crossing I dimly saw by the rays of the headlight something lying on the timbers of a cattle guard and which I took to be a man.

Everything possible was done to stop but the object was struck and thrown several feet from the track. Still believing the victim to be a man, upon coming to a standstill several of us went back and found—not a man but a large hog, lying cold in death—which indicated beyond question that the animal had passed that bourne from which no swine returns several hours at least before its violent contact with the pilot.

At the trial the farmer was the only witness in his own behalf and his statements became badly mixed during cross-examination. Detectives were able to show that the hog had been dragged from the pen beside the road to the crossing and also a witness was produced, who when driving along the highway had passed the farmer standing beside the road not far from the crossing and a hog lying near him some hours before the train came along. It may perhaps be needless to add that the farmer did not collect damages but at the termination of a trial some time later he did collect a sentence of two and half years in the Iowa State penitentiary for placing an obstruction on the track and the last I heard of him he was biding his time in that institution, from which, I trust, he came out a better and wiser man.

New Haven's New Electrical Repair Shop.

A new electrical repair shop designed to handle all of the now extensive electrical equipment of the New York, New Haven & Hartford Railroad, costing $650,000 and covering two acres of ground, is nearing completion in Van Nest, Bronx, Borough, New York City. It is expected that it will be in operation by August 1, or a short time before the electrification of the road from Stamford to New Haven is finished.

The electrical equipment of the New Haven road is assuming large proportions, it having a total of 99 electric locomotives and 23 multiple unit motor cars. Forty-seven of the locomotives are used in the passenger service, 36 for freight and 16 as switches. The freight engines are 50 feet long and weigh 150 tons. They have four drivers on a side, and these are driven by eight motors. They will exert a maximum tractive effort of 40,000 tons and will haul a 1,500-ton freight train at a maximum speed of 35 miles an hour.

Enlargement of Angus Shops, Canadian Pacific Railway.

The following extensive additions are being made to the Angus Shops, Montreal, the percentages given in connection with some of the works showing the amount of work completed last month as advised us officially:

Steel passenger and freight car shops, comprising material shops, 182 by 100 ft., and 209 by 100 ft.; passenger car shop 202½ by 110 ft.; freight car shop, 405 by 72 ft.; transfer table, 80 by 75 ft., 80 per cent. done; bolt and nut shop, 420 by 60 ft., 25 per cent. done; new shipping platform for wheel foundry, 100 by 72 ft.; extension to scrap platform and shed, 60 by 50 ft.; extension to pattern storage, 60 by 50 ft.; addition to car ovens, 3 new ovens; extension to locomotive shops, 594 by 80 ft.; 20 per cent. done; addition to tube rack; extension to office building, 80 by 75 ft.; extension of power house, 20 by 62 ft. 11 ins., 30 per cent. done; extension of upholstering shop, 80 by 75 ft., 30 per cent. done; extension to frog shop finished.

American Locomotives.

The number of locomotives ordered in the United States during the year 1912 was 4,515, which may be taken as a fair average figure for the period of 10 years since records dealing with the subject were instituted. The statistics show an enormous increase in the demand for 2-8-2 type engines, a type as yet untried on British railways, and it is interesting to note that of all the large output of locomotives, only five out of a total of many hundreds for passenger service were of the Atlantic type.

Ten Wheel Type Locomotive for the St. Louis Southwestern

At the present time, the two locomotive types most prominent in American practice are unquestionably the Pacific and the Mikado, which are being built in large numbers for passenger and freight service respectively. These designs have been introduced in response to a demand for locomotives having not only high hauling, but also high steaming capacity; and their performance, in the heaviest class of service, is proving most satisfactory.

There are, however, many lines where traffic conditions are such that the high steaming capacity afforded by locomotives with trailing wheels is not required, and where engines having simpler wheel arrangements, with a greater percentage of weight on drivers, are entirely capable of handling the traffic. These conditions are found on the St. Louis Southwestern Ry., which has recently received ten passenger locomotives of the ten-wheeled type, and an equal number of freight locomotives of the Consolidation type, from the Baldwin Locomotive Works.

The ten-wheeled locomotives exert a maximum tractive force of 33,400 lbs., and are designed to haul trains weighing 470 tons up a grade of one per cent. at a speed of 30 miles per hour. The total equivalent heating surface, making the usual allowance for the superheater, is 3,256 sq. ft., or 264 sq. ft. per cubic foot of cylinder volume—a liberal allowance for an engine of this type.

The boiler is of the extended wagon top type, designed to accommodate a 30 element superheater. The small boiler tubes are spaced with ⅞-inch bridges. The firebox has a vertical backhead and sloping throat, and the mud ring, forward of the rear drivers, is inclined in order to give the greatest possible depth under the tubes. The front end of the crown is supported by three rows of flexible staybolts. In the fourth row, the two center bolts are rigid, and the number of such bolts is increased in each succeeding row from the front, until from the thirteenth row to the back of the box, there are twelve. The forward half of the crown is thus supported, on each side, by a group of flexible bolts covering a triangular area. Such bolts are also liberally used in the sides, throat and back, the total number employed in this boiler being 781.

The grate is arranged with a central longitudinal bearer, and the grate bars are interchangeable with the standard bar used by the St. Louis Southwestern in narrow firebox engines.

The steam distribution is controlled by 14-inch piston valves, which are driven by Walschaerts motion. The cylinder and steam-chest heads are of cast steel, and the cylinders are fitted with both relief and by-pass valves. Hunt-Spiller iron is used in the steam-chest bushings and valve packing rings; also in the piston bull and packing rings, the crosshead shoes, and the bushings in the solid-end side rod stubs.

The front truck has a rigid center. The driving tires are all flanged, but the setting is such that the total play between the flanges and rails is ⅜ in. greater on the front and rear pairs of wheels than on the main pair.

The tender has a cast steel frame, and the trucks are of the equalized pattern, with side frames and center piece of steel, in one casting. The truck boxes are of cast iron with vanadium content.

The Consolidation type locomotives exert a tractive force of 50,200 pounds, and are in many respects similar to the ten-wheelers. Wherever practicable, the details interchange, either with those of the passenger locomotives, or with those of other classes of engines previously built for this road. The tenders used with the Ten-wheeled and Consolidation locomotives are practically alike.

The following are the principal dimensions of these two classes of locomotives:

TEN-WHEELERS.

Gauge, 4 ft. 8½ ins.; cylinders, 22 ins. x 28 ins.

Boiler.—Type, wagon top; diameter, 72 ins.; thickness of sheets, ¾ ins. and 13/16 ins.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Fire box.—Material, steel; length, 102 ins.; width, 70 ins.; depth, front, 72 ins.; depth, back, 58¼ ins.; thickness of sheets, sides, ⅜ ins.; thickness of sheets, back, ⅜ ins.; thickness of sheets, crown, ⅜ ins.; thickness of sheets, tube, 9/16 ins.

Water space.—Front, 5 ins.; sides, 4 ins.; back, 4 ins.

Tubes.—Diameter, 5⅜ ins.; 30, No. 9 W. G., 2 ins.; 212, No. 11 W. G.; length, 15 ft.

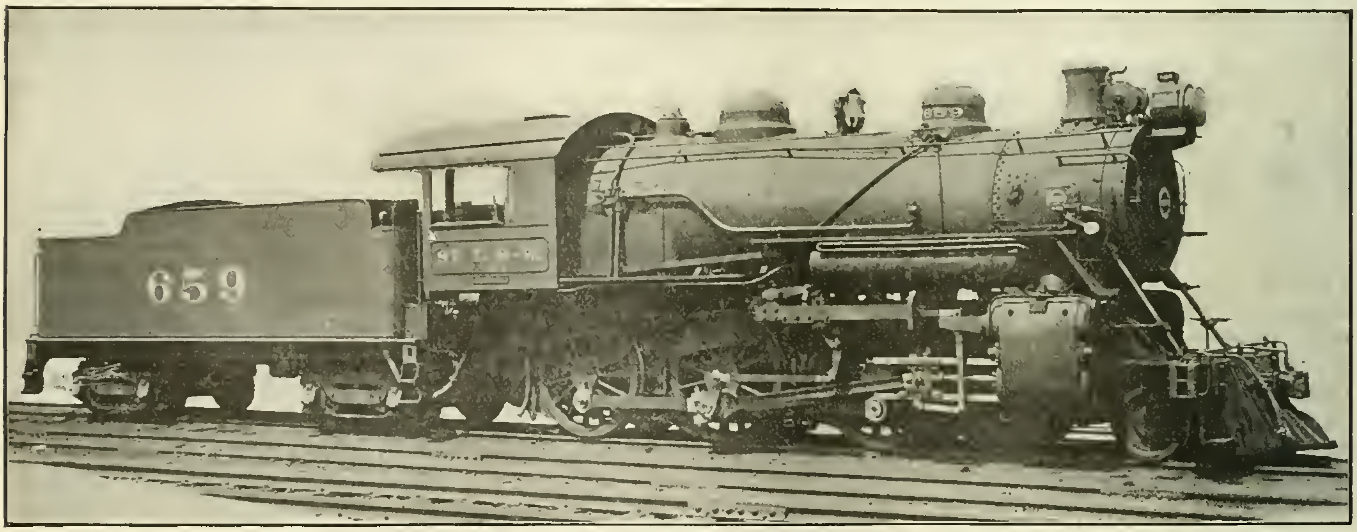
Heating surface.—Firebox, 173 sq. ft.; tubes, 2,285 sq. ft.; total, 2,458 sq. ft.; grate area, 49.6 sq. ft.

Driving wheels.—Diameter, outside, 69 ins.; diameter, center, 62 ins.; journals, main, 10½ ins. x 13 ins.; journals, others, 10 ins. x 13 ins.

Engine truck wheels.—Diameter, front, 33 ins.; journals, 6 ins. x 12 ins.

Wheel base.—Driving, 15 ft.; rigid, 15 ft.; total engine, 26 ft. 2 ins.; total engine and tender, 61 ft. 5¼ ins.

Weight.—On driving wheels, 164,680 lbs.; on truck, front, 44,520 lbs.; total engine, 209,200 lbs.; total engine and tender, 380,000 lbs.



TEN-WHEEL, 4-6-0 TYPE LOCOMOTIVE FOR THE ST. LOUIS SOUTHWESTERN RAILWAY.
Thos. E. Adams, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 9,000 gals; fuel capacity, 15 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 532 sq. ft.

CONSOLIDATIONS.

Gauge.—4 ft. 8½ ins.; cylinders, 25 ins. x 30 ins.; valves, 14 in. piston.

Boiler.—Type, straight; diameter, 80 ins.; thickness of sheets, 13/16 ins. and ⅞ ins.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Fire Box.—Material, steel; length, 108 ins.; width, 70 ins.; depth, front, 75¼ ins.; depth, back, 64 ins.; thickness of sheets, sides, ⅜ ins.; thickness of sheets, back, ⅜ ins.; thickness of sheets, crown, ⅜ ins.; thickness of sheets, tube, 9/16 ins.

Water space.—Front, 5 ins.; sides, 4½ ins.; back, 4½ ins.

Tubes.—Diameter, 5⅜ ins.; 32, No. 9, W. G. 2 ins.; 245, No. 11 W. G.; length, 15 ft.

Heating surface.—Firebox, 185 sq. ft.; tubes, 2,585 sq. ft.; total, 2,770 sq. ft.; grate area, 52.5 sq. ft.

Driving wheels.—Diameter, outside, 57 ins.; diameter, center, 50 ins.; journals, main, 10½ ins. x 13 ins.; journals, others, 10 ins. x 13 ins.

Engine truck wheels.—Diameter, front, 30 ins.; journals, 6 ins. x 12 ins.

Wheel base.—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total engine, 25 ft. 6 ins.; total engine and tender, 62 ft. 3¼ ins.

Weight.—On driving wheels, 201,500 lbs.; on truck, front, 28,800 lbs.; total engine, 230,300 lbs.; total engine and tender, 402,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 9,000 gals.; fuel capacity, 15 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 578 sq. ft.

Oil Fuel on the Canadian Pacific.

The chief engineer of the Canadian Pacific Railway recently made a trip of inspection to Vancouver and Victoria for the purpose of investigating the cost and feasibility of using oil in the locomotives on the Cascade subdivision of the British Columbia division, both in passenger and yard engines. Oil tanks will be established at Vancouver, Coquitlam, Mission Junction, and North Bend to supply the fuel for the locomotives. The work of converting will be done at the local shops. Oil has been used for fuel purposes for some time on the sections between Kamloops and Field, and it is planned to extend the system to the other portions of the road. Engines on some of the branch lines of the Province have also been using oil for fuel. After the engines on the Cascade division have been changed and placed in commission it is intended to extend the plan to the section between North Bend and Kamloops, completing the change on the entire British Columbia division.

The Quebec Bridge.

The revised design for the Quebec Bridge is so far advanced that details of the principal members are available. The main span is 1,800 ft. long. The top chord members of the cantilevers will consist of double lines of 16 in. I-bars. The bottom chords will be 7 ft. in height by 10 ft. wide. The length from panel to panel point will be 86 ft., and each full panel of the bottom chord for one truss will weigh 200 tons. Each cast iron base for the towers will weigh 500 tons. The stringers reaching from panel point to panel point are massive plate girders 10 ft. in depth, each weighing about 60 tons. The work is progressing rapidly and arrangements are being made to continue the work during the winter months, which will greatly hasten the completion of the work.

Peat Powder as Fuel.

The announcement that Hjalmar von Porat, a Swedish engineer, had perfected a process for utilizing peat powder as fuel for locomotives has awakened interest in the possibility of developing the extensive peat bogs of Sweden for this purpose.

The powder is manufactured by the Ekelund process. It does not appear that this process has made much headway as yet, but it is now predicted that in connection with the discovery of Mr. von Porat, the use of peat powder will in time become extensive.

In the von Porat system the peat powder is fed by an automatic device into the furnace of the locomotive, which is specially arranged to consume it. According to Mr. von Porat, the results obtained with peat powder may be summed up as follows:

Substantially the same results can be had from 1½ tons of peat powder that 1 ton of coal will produce. Peat powder may be burned with an admixture of about 5 per cent. of coal. As to firing with peat powder, the work is almost nothing in comparison with firing with coal, because the powder is forced into the furnace by automatic process. No change had to be made in the boiler and none in the firebox, except installing the special apparatus. There is no difficulty in bringing the powder from the tender to the fire box, as it passes through a conveyance pipe. Another advantage in using peat powder is that no cold air can get into the firebox and neither smoke nor sparks escape from the smokestack.

As a result of von Porat's invention, it is reported that a number of the Swedish railways are preparing to use peat powder instead of coal, and the experiment is being watched with much interest by the leading railroad experts in Europe and elsewhere, as in many countries peat fuel is readily available and can be had at much less cost then coal.

CONSOLIDATION 2-8-0 TYPE LOCOMOTIVE FOR THE ST. LOUIS SOUTHWESTERN RAILWAY.

Twenty-first Annual Convention of the Traveling Engineers' Association

The Traveling Engineers' Association held their twenty-first annual convention in Chicago, August 12, 13, 14 and 15.

President W. H. Corbett, in a very sensible inaugural address, mentioned that the association had attained its majority, the present being the twenty-first annual convention, a protracted history which represented unfailing industry and commendable enterprise in holding faithful to the motto, "To improve the locomotive service of all American railroads." Referring to the work done by the association he said:

"It was no slight task to conceive and build up an organization such as this that helps to move the world to better and greater things. The few far-seeing men who realized the great amount of good to be derived from learning other people's point of view, and who gave their time and labor to give it its first start, surely 'builded better than they knew.' Good works seldom show results in the lifetime of those who sow, hence we are fortunate that the efforts made a few years ago show such wonderful results in such a comparatively short time, but there is always more to be done.

"There is probably no mechanical organization in the country that can compete with ours in the intense interest and the desire for information displayed by a majority of the members, and in the practical every-day subjects that are discussed and the intelligent handling of the same.

"The road foreman of engines is so close to the locomotive and to the men of the locomotive that his responsibilities are perhaps greater than any other person connected with the handling of the train. He should know by sight and by sound almost immediately when anything goes wrong with the engine. He should keep posted in advance on all the new appliances, and should learn to use them to the best possible advantage and be able to quickly estimate their value to the service. He must take a personal interest in his work, his mind ever quick and alert to grasp each new device as it comes. Engineering is not what it was ten or even five years ago; new devices are constantly being applied and the engines are getting larger and heavier.

"There are so many interesting subjects brought up at our annual meeting, so much good, practical information to be gained, that every road foreman of engines should make an effort to be present at the session. The new ideas and good first-hand experiences that he listens to, must fill him with enthusiasm so that when he returns to his home and his work, he takes with him higher ideals and a mind firmly convinced to use his newly-acquired knowledge to the best advantage in improving the service in his territory. I hope that all the members will take an active part in the discussions so that all may benefit by the exchange of ideas, and I sincerely hope the new members will feel free in expressing their views."

After paying a high tribute to the services for the association performed by Clinton B. Conger, President Corbett gave some particulars of the work to be done by the convention and urged the members to attend the sessions and pay close attention to the proceedings.

REPORTS OF COMMITTEES

Superheat Locomotives.

The first report read was that on Uniform Instruction to Enginemen on Handling of Superheat Locomotives. Mr. J. W. Hardy was chairman of the committee that prepared this report and was assisted by Messrs. Sheridan Bisbee, W. A. Buckbee, B. J. Feeny, and J. W. Heath.

After mentioning the experiments of Dr. Wilhelm Schmidt with superheat some twenty years ago and the subsequent success achieved which have put over 12,000 superheaters upon European railways and 7,000 upon railroads in the United States, the report proceeds to give particulars of the Schmidt invention as follows:

The device consists of several large flues located usually in the upper part of the boiler and which contain a system of tubing known as superheat units. The units are connected to a header located in the smoke-box and in direct connection with the dry-pipes and steam pipes.

The steam, after leaving the boiler, passes through the units on its way to the cylinders and in so doing absorbs heat from the fire-box gases as they pass through the large flues, and the steam becomes superheated, its temperature being increased to as high as 250 degrees above that in the boiler and without changing its pressure.

The smoke-box is so constructed as to form a box-like arrangement enclosing the superheater parts in the front end with an opening between it and the remainder of the smoke-box. This opening is controlled by a damper, the object of which is to protect, when closed, the units from becoming overheated by shutting off the flow of gases through the large flues when steam is shut off.

The superheater damper is operated by a counter-weight and a small steam cylinder located on the outside of the smoke-box, to which is connected a steam pipe leading from the valve chamber or blower connection as the case may be.

Steam as generated in the boiler is known as saturated steam and remains as such as long as it is contained in the boiler and its temperature is the same as the water from which it was generated, but in passing through the superheater it is capable of absorbing additional heat, thus increasing its temperature and its volume, but NOT its pressure.

The principal advantages derived from the use of superheated steam are: The increased volume of steam delivered per unit of water evaporated, the prevention of cylinder condensation, and a much smarter engine. When we consider the fact that the heat losses in the cylinders of a saturated steam locomotive average easily 30 per cent., due to cylinder condensation, which is eliminated with highly superheated steam, and in addition the increase in volume, it is an easy matter to see why the superheater locomotive produces such remarkable results in the way of efficiency and economy.

Add to this the fact that the efficiency of the superheater locomotive increases as the load increases, while it is the reverse with saturated steam, and we have the reason for its being generally adopted by the railroads.

In the operations of a superheater locomotive it is necessary, as with all other devices, in order to obtain the most efficient and economical performance, that the enginemen be familiar in a general way with the construction and operation of the superheater as well as the nature of superheated steam, and while the operation does not require any radical departure from what has been the recommended practice for saturated steam locomotives,

there are some operating features which, if followed closely, will produce the desired results, while on the other hand, if they are not followed, the results are unsatisfactory and the full efficiency and economy of the superheater locomotive will not be obtained.

It is this feature of the superheater locomotive that we propose to deal with in this paper and your committee feels that with the aid of the discussion following the reading of the paper this Association will be in a position to recommend "Uniform Instructions to Enginemen on Handling of Superheat Locomotives" that will meet with the approval of the best authority on the subject, and, if followed, will give to the railroads the benefits of remarkable results in the way of increased efficiency and economy which the superheater locomotive is capable of delivering.

DRAFTING AND FIRING.

One of the most important features to be considered is the firing question. Inasmuch as the efficiency of the locomotive increases as the degree of superheat increases, it can readily be seen that the flame temperature in the fire-box is a very important factor and it is quite necessary that the draft appliances be so constructed as to produce an even, steady pull over the entire grate, and a draft condition that will make the locomotive a free steamer. In order to obtain this, it is generally necessary to use a somewhat smaller nozzle, draft-pipe and stack arrangement.

On account of the smaller volume of exhaust steam and its higher velocity, a moderate reduction in the size of the exhaust nozzle does not produce the same bad effect as with saturated steam, and its reduction to produce the desired draft conditions may be reached before there is any noticeable effect in the way of back pressure. However, the necessity for these changes depends much upon the quality of fuel used and the operating conditions.

Firing should be light and regular and a high flame temperature maintained.

Keep a light fire, a bright fire and a level fire, and if you do this you will have a HOT fire and this is necessary to obtain best results. Close the fire-door after each shovelful.

Banked fires and applying fuel in large quantities MUST be avoided, as this practice produces a low flame temperature, which materially reduces the degree of superheat and affects the economy and efficiency of the locomotive.

The kind of coal to be used has to be considered. For illustration: A superheater locomotive will give less trouble and will be more efficient using Colorado or New Mexico coal than it will with Iowa or Arkansas coal; this is on account of the former coals being almost free from clinker and slag forming properties, while the latter is very bad to clinker the grates and honeycomb the tubes, superheater units and flues. This is especially true during wet and snowy times when the percentage of moisture is high in the coal, all of which has to be evaporated before the coal will burn, and while this evaporation is taking place, instead of having a white burning fire, we have a red, smoky looking fire that has a temperature just up to the melting or fusing point, and the impurities which are present more or less in nearly all coal, melt and run and form clinkers in the fire and on the flue-sheet, in tubes and flues. This occurs worse with old flues than with new ones.

The way the engineer starts his train has a great deal to do with this also. If in starting he gives his engine too much throttle, the first move causes the engine to slip, which helps to form clinkers and honeycomb on the flue-sheet and superheater units.

When making a terminal start, the condition of the steam being used is exactly the same as ordinary wet or saturated steam, and this condition continues until the superheater elements get in their good work, the steam gradually getting hotter and hotter and drier and drier. Enginemen should be interested in having flues kept clean.

Any stoppage of the flues reduces the boiler heating surface and in case of the superheater flues also reduces the degree of superheat, as the steam passing through the unit contained in the plugged flue is not superheated and when it is delivered in the superheat portion of the header its effect on the superheated steam is to reduce its temperature.

The enginemen should report promptly any indications of trouble in the front end, or other trouble that will in any way affect the free steaming of the locomotive.

Experience has shown that a very bad condition can exist in the front end of a superheater locomotive, and still the performance be reasonably satisfactory. Many cases have occurred where these conditions have become bad enough to cause a failure ordinarily before it was known that there was anything wrong.

Enginemen should always bear in mind that if a superheater locomotive does not steam freely there is something wrong which should be corrected at once.

Enginemen should report promptly any failure of the superheater damper to work properly, and in case it fails to operate on the road the damper weight may be tied up to hold the damper in open position until the trip is completed, and to avoid a failure.

If for any reason the damper on a road locomotive does not close when the throttle is closed, the engineer can always protect the superheater units from overheating by slightly cracking the throttle when in his judgment it is necessary.

BOILER FEEDING.

Another feature to be considered important is boiler feeding. Enginemen should feed the water regularly and carry it at a uniform level, making sure that it is not high enough to carry over into the superheater.

Any water carried over into the superheater will be evaporated by the heat passing through the large flues, and in this case the superheater is being used as an auxiliary boiler with little or no superheat obtained. This is one of the most common and expensive mistakes made in operating this class of power.

Enginemen should bear in mind that the water consumption should be about one-third less than with a saturated steam locomotive in doing the same work and should regulate the boiler feed accordingly.

Enginemen should avoid the practice of filling the boiler too full before starting or when drifting.

Where the above practice is followed, the locomotive is slow getting under way, due to the superheat coming up slowly and usually the engineer runs two or three miles before it is necessary to apply the boiler feed and much steam is wasted at the safety valves.

Enginemen should always note the height of water in the boiler when taking charge of a superheater locomotive and should not attempt to move it until the air pressure is pumped up and the brake in operation.

The common practice of filling boilers too full of water in engine houses and yards, makes the above instructions necessary, because when the boiler is too full and the throttle is opened, the large volume of water passing into the superheater makes it difficult to handle the locomotive, particularly if the engineer is not aware of the conditions. This, however, is a very bad practice and should be stopped, but indications are that it never will be.

Cylinder cocks should be open before starting and remain open until dry steam appears, except when making station stops, when there is not liable to be any condensation in the cylinders.

Enginemen should run with a wide-open throttle where the working con-

ditions will permit, and with as short a cut-off as is consistent with the proper handling of the train.

It is not expected that an engineer will attempt to run with a wide-open throttle with a very light train and he should not handle a heavy train with a light throttle and an unnecessarily long cut-off.

Enginemen should bear in mind that the application of the superheater has practically increased the boiler capacity, and as the efficiency of the locomotive increases in proportion to the increased pull on the draw-bar, they can work the engine much harder than is possible with saturated steam, when occasion requires it.

Toward the end of the report considerable attention was given to the subject of lubrication, but it did not vary much from the standard instructions to engineers running saturated steam locomotives. The report concluded with a section of don'ts that are worth committing to memory.

The report was read by Mr. J. W. Hardy, chairman of the committee.

DISCUSSION.

Chairman Corbett considered that much credit was due Mr. Hardy and the other members of the committee for the excellent report read. There is only one good smoke prevention device invented, which is the engineer and fireman. The same may be said of superheaters. If the engineer and fireman will live up to the recommendations of this committee the railroads will be surprised at the great efficiency and saving of fuel.

Mr. Fred. McArdle wanted to know why the committee recommended that superheat locomotives should be run with a wide open throttle and short cut-off.

Mr. Hardy replied that by using a wide open throttle a higher degree of superheat is secured.

Mr. W. A. Buckbee gave an explanation of why with big modern engines it is not so economical to run with a full open throttle as it was with smaller boilers.

Mr. J. C. Petty wanted to know if any of the members are operating slide valve engines with a high degree of superheat.

Mr. W. R. Davis answered that his company had changed a slide valve engine to use superheat. Wilson's slide valve was used and it operated without giving any trouble, except that it is difficult keeping the quadrant tight.

Mr. Petty asked if Mr. Davis could give the degree of superheat he was getting with the slide valve engine.

Mr. Davis was not certain but believed it to be above 500 degrees.

Mr. D. L. Eubank's experience had been that with a wide open throttle and short cut-off used with excessive steam pressure there is so much pressure put upon the top of the valve that the valve moves irregularly. It had been his observation that by working a longer cut-off and tight throttle fuel was saved and the engine worked more smoothly.

Mr. Ryder contended that from 25 to 30 per cent. was the proper cut-off.

Mr. Buckbee said that it was next to impossible with some of our engines using superheated steam to operate with a wide open throttle without carrying water into the cylinders. Some of our best engineers have carried water so when running fast trains with saturated steam to approach the danger point in order to get dry steam into the cylinders. While you would not probably notice any water in the cylinders, there may be water passing into the superheater which becomes an auxiliary to the boiler.

Experience has taught us that we cannot instruct an engineer how to carry the water. That must be left to his judgment, but we may make him understand that he must not carry the water high enough to pass into the superheater. If he can get information concerning the construction and operation of superheaters, and the engineer is not a blockhead, he will understand it.

In some cases where old engines have been changed to superheat the injectors are too large and give engineers trouble in regulating. He thought mechanical officials ought to show more readiness to reduce the capacity of injectors where engines have been changed to superheaters.

Mr. F. P. Roesch took issue with previous speakers on the open throttle and short cut-off. He mentioned a case where they were testing an engine with a Schmidt superheater, where when a change from a heavy to a light grade was made the superheat dropped from 680 to 600 degrees. Then by simply reducing the throttle opening and increasing the cut-off the temperature rose again to 680 degrees.

Mr. Buckbee made some remarks on the shortest point of cut-off and insisted that from 25 to 30 per cent. is as short as can be used with advantage to the smooth working of the engine. He agreed with Mr. Roesch that the superheater depends entirely upon fire conditions. His experience had been that superheating was most effective at cut-offs from 25 to 30 per cent. with wide open throttle for a heavy train running from 25 to 30 miles an hour.

Mr. McArdle said that in early days the engineer used to have a mark on the quadrant and one for the throttle lever, which he used as guides in operating the engine. He did not believe in measuring cut-off by inches but by the working conditions.

Mr. Eubank asked: How much more expansion is there in superheated steam to offset the shorter cut-off you give superheat engines?

Mr. Petty said that it has been proved in tests that with every 100 degrees of superheat added you get 12½ per cent. more volume, so that if you get 250 degrees of superheat you will get about 35 per cent. more volume of steam.

A protracted discussion on superheated steam, water, cylinder condensation, throttling, size of nozzles, etc., which was participated in by Major Ryder, Buckbee, Roesch, Petty, McArdle, Collett and Eubank which finished the morning's session.

SECOND SESSION.

On resuming the discussion on superheaters Mr. Buckbee spoke at considerable length on the Firing Question. "We are depending entirely," he said, "on the firebox temperature for superheat after we get the engine in service and we have a different class of men to contend with than we have on the other side of the engine. In many instances the fireman has lost interest in the operation of the engine. We have to educate firemen. The training a fireman received in throwing large quantities of coal into the firebox of a saturated steam engine in order to keep up the steam has a bad effect on a superheat engine where it is important and essential to maintain a high flame temperature."

Mr. A. G. Kinyon defended the fireman and thought that he performed his difficult duties as well on superheaters as on saturated steam engines and that, as a rule, his work was done better than that of the engineer.

Mr. J. J. McNeill asked a question about the different qualities of coal and how far they affected the efficiency of the superheat engine. Then it drifted into a long discussion about the honeycombing on the heating surfaces which some kinds of coal deposit.

After that a long discussion ensued on lubrication of superheat locomotives which brought out nothing new or startling.

Both the reading of the paper and the discussion created the liveliest interest among the members, and for these reasons we have given more space to the subject than we otherwise would have done, with the result that it is impossible for us to present reports of the other papers in this issue of Railway and Locomotive Engineering, but will continue in next month's issue, and endeavor to do all that we can to give a reflex of the work that is being done by the special committees appointed to present reports on the subjects submitted to them.

Newark Bay Bridge Destroyed and Rebuilt

The destruction of the Newark Bay Bridge by fire a few weeks ago was looked upon as a calamity that threatened a suspension of traffic for a considerable time on both the Pennsylvania and Lehigh Valley railroads. Its nearness to New York, and the enormous car loads of freight passing over the bridge every day gave the disaster a more than usual gloomy interest.

Twelve and a half days later a new trestle bridge, temporarily replacing the former structure, was in service. It took 1,500 men working day and night, backed up by all the resources of a great organization, to accomplish it.

When the fire started a Pennsylvania Railroad freight train from the South with thirty-five cars of potatoes bound for New England was on the bridge. The engine and the first five cars got across into Greenville safely; the flagman of the train, seeing the danger ahead, cut off the cabin car at the end of the train, and pushed it to safety himself. The remaining thirty cars of potatoes were totally destroyed, and the debris sunk with what was left of the bridge.

The Pennsylvania Railroad's Newark Bay drawbridge between Newark and Greenville was 5,653 feet long; the draw itself was 264 feet long. Over it about 1,600 freight cars passed daily, cars with food products, coal and iron, for New England and Long Island, and in return came cars loaded with the output of factories of that section.

Fire, caused probably by sparks from a locomotive, started on one of the two parallel bridges—one owned by the Pennsylvania Railroad and the other by the Lehigh Valley—about 1,200 feet from the Jersey shore, and, fanned by a land breeze, worked its way rapidly to the Greenville shore. About 3,500 feet of both bridges were burnt.

Once it was seen that the fire would put the bridge out of commission, the first thing to be done was to provide for an alternative freight route to New England. Traffic was sent north from Trenton over the Pennsylvania Railroad to Belvidere, N. J., where connection was made with the Lehigh and Hudson Railroad, which crosses the Hudson River on the Poughkeepsie Bridge. Some 5,000 cars were handled to and from New England this way. The Hudson River docks of the Delaware, Lackawanna and Western and the Erie railroads were also placed at the disposal of the company. So promptly were these arrangements made that the hundreds of cars of perishable freight went through to their destinations without delay.

It was decided that each road should build one track, thereby giving a two-track bridge when both had finished. The Lehigh Valley bridge builders started at the west end of the bridge, while the Pennsylvania men worked in the opposite direction.

RUINS OF NEWARK BAY BRIDGE AFTER DESTRUCTION BY FIRE.

Here are a few things the engineers were ordering while the fire still burned: Fourteen pile drivers, thirteen marine derricks, twenty-one scows, two tugs, six catamarans, five air compressors, three water boats, two derrick cars, two locomotive cranes, three switching engines, two teams of horses, 3,000,000 feet of lumber and 1,500 men. As the work progressed much other equipment was added.

NEWARK BAY BRIDGE AND TRAIN OF CARS ON FIRE.
(Photograph taken at 1:15 a. m.)

Not a little trouble was experienced with the steel trucks and underframes of the cars in the potato train which had fallen in the bay. Many of them had lodged between the piles, and it was necessary first to remove them before sawing off the burned piles at the water level, for on top of these burned piles were to be laid transverse sills a foot thick, and on these a new trestle of timbers just as heavy. As the bridge now stands the track level is about twenty-six feet above high water.

Another obstacle the engineers met at first was the thousands of feet of steel rails which lay twisted among the charred piles, but speedy work was made of it when two hundred men were set to work cutting the rails in small sections so they could be handled with some ease.

Every minute counted with the engineers in charge of the work. They had 1,000 men working in the day, and 500 at night; they built an average of ten feet of bridge every hour. They were paid one and a half times the regular compensation for their hurry. The total loss to the company was $295,000, for the former bridge was not an old one; it was built in 1904 and was a modern structure in every way.

J. B. Fisher, superintendent of the New York Division, was in entire charge of the reconstruction of the Newark Bay Bridge.

Canadian Pacific Railway Shops at McAdam Junction, N. B.

The C. P. R. is building an erecting shop and machine shop at McAdam Jct., N. B. The shops when completed will be 150 by 130 ft., comprising six stalls, one of which will be equipped with an electric locomotive lift. The construction will be entirely of concrete, reinforced where required, and finished with white cement.

The erecting shop will form the high portion of the shops, extending to a height of 40 ft. with a flat roof supported on heavy purlins and steel trusses spanning about 70 ft. Running the whole length of the erecting shop there will be a five-ton electric traveling crane equipped with all the necessary motors.

The machine shop will be 80 ft. across, with concrete walls, steel columns and beams, and mill construction roof, and when completed will be equipped with all the necessary tools and mechanical labor saving machines. In connection with the machine shop there will be a lavatory, tool room and foreman's office.

The erecting and machine shops will be heated by hot air, and the car repair shop by steam, and they will be electric lighted throughout. Work on the foundations is well advanced, Henry Post, of Woodstock, N. B., being the contractor.

Questions Answered

BOILERS AND TUBES.

A. E. J., Washington, D. C., asks: 1. What is the difference between a Belpaire boiler and a crown bar boiler square top? 2. What is the difference between a fire tube boiler and a water tube boiler, and to which class does a locomotive belong? 3. If the barrel sheet, originally ½ in. in thickness, is found to be reduced by corrosion to ⅛ in., would the boiler be considered safe, and what recommendation should be made in view of the condition of the sheet? 4. How is a crack 3 ins. long in the barrel sheet of a boiler, or in a fire-box sheet repaired? A.—1. A boiler having a fire-box with a flat crown sheet joining the side sheets by a curve of short radius and having the outside crown sheet and the upper part of the outer side sheets flat and parallel to those of the inner fire-box. These flat parallel plates are then stayed by straight direct vertical and transverse horizontal stays, precluding the necessity of crown bars to support and strengthen the crown sheet. 2. A fire tube boiler, as the name implies, is a boiler where the flues are open to the fire and the heated gases pass through the flues, the flues being surrounded by water. A water tube boiler, on the contrary, is so constructed that the water circulates inside the flues while the heated gases pass over the outside of the flues. A locomotive belongs to the fire tube class. 3. The boiler would not be considered safe, and a new barrel, if not a new boiler, would be the proper recommendation. 4. The prevailing practice has been until recently to cut out a portion of the sheet and apply a patch lapping over a sufficient space to admit of a row of rivets or patch bolts to secure the patch in place. Since the introducing of various welding processes, however, cracks in boiler and fire-box sheets have been very successfully closed by cutting a groove extending over the crack and with the application of a fusing torch fill the groove with new metal.

INJECTORS, LUBRICATION AND VALVE GEAR.

W. G. L., New York City, asks: 1. Will an injector supplied with highly superheated steam handle water at 212 degs. or more? 2. Are injectors ever worked with superheated steam? If not, why not? 3. A man told me that better lubrication is possible with superheated steam because saturated steam with its particles of water tends to carry away oil through the exhaust. Is this correct? 4. In the link motion, the link hanger is placed off center to allow for angularity of main rod and in other gears such as the Joy and Baker the valve events in relation to the piston are almost perfect. What I wish to know is, why are not valve gears set out in relation to the crank pin instead of the piston? The leverage of the piston when it is at half stroke and when the crank pin is on the lower quarter are practically the same. A.—1. No. Superheated steam would not add to the effective working of the injector. Ordinary injectors will operate with a feed-water temperature of about 154 degs. Fahr. or under. The Hancock Inspirator will operate with feed water at 125 degs. F. at steam pressures from 60 to 230 pounds. Superheating does not raise the pressure of the steam. 2. Injectors are not worked with superheated steam. It would be of no appreciable benefit and would add to the appliances necessary. 3. No. Lubrication is more difficult with superheated steam, especially with lower grades of oil as the lubricant is more readily carbonized with steam at a high temperature. 4. The necessity for adjusting the opening of the valve as well as its duration of opening to the travel of the piston is apparent when we consider that it is to the piston to which the power is applied, and it is of the utmost importance that both the opening and closing of the valve should occur at the same point of piston travel on the forward and backward strokes of the piston, with such slight variation as may be allowed for the amount of space occupied by the piston rod on the forward stroke. The motion of the valve itself in its relation to the piston is the only practicable guide, and however exact the crank or eccentrics may be adjusted, other movable parts affect the location of the valves.

BALANCED VALVES.

J. P. C., Norwood, Mass., asks: What is the formula or rule for ascertaining the ratio between the balanced and unbalanced portion of a slide valve?—A. It is purely a matter of dimensions, and there is no exact rule in regard to the ratio of balancing, depending as it does on the size of the slide valve, valve yoke, and the amount of lap on the valve. For example, assuming that the face of the valve measures 8 inches by 14 inches, this would give an area of 112 inches, which in the case of a pressure of 160 pounds per square inch would place a pressure of 17,920 pounds on the valve. Now supposing the upper surface of the valve is balanced by means of balance plate, and strips, and supposing this space measures 6 inches by 14 inches, making an area of 84 inches. This prevents a pressure of 13,440 pounds from resting on the top of the valve thereby greating reducing the pressure on the valve face. The result is less friction and less lubrication required. A hole is usually drilled in the top of the valve leading to the exhaust cavity to permit the live steam that may pass in over the strips to pass out to the exhaust when the exhaust port opens.

INJECTOR "BREAKING" WHILE DRIFTING.

W. L. B. Bonavista, Newfoundland, writes: I have noticed the injector to "break" occasionally with engine "pulled over," while drifting. Does the air pumped into the boiler in the absence of relief valves have anything to do with this. A.—No. It is a mere coincidence. A sudden disturbance whereby the water in the boiler may be thrown backwards to some extent and mixed with the steam entering the injector will stop the injector, but compressed air driven back through the dry pipe will not stop the action of the injector.

AIR PRESSURE.

J. D., New Haven, Conn., asks: Is there any certain degree of leakage through the pores of metal pipes containing compressed air? A.—No, unless there is some defect in the pipes. In actual practice in street cars and other appliances air pressure as high as 2,000 pounds has held its pressure for several days without any diminution. The joints, as a rule, are the cause of leakages.

EQUALIZING BRAKING POWER.

W. M. Princeton, Ind., writes: After a light initial application of the brakes on a freight train, will a continued or heavier reduction tend to equalize the braking power obtained on the different cars in the train A.—Viewed from an empty and loaded car point of view it will not, but with unequal piston travel, which is the rule rather than the exception, it will. If you have the copies of the 1912 issues, or a copy of "Developments in air brakes for railroads," by Mr. W. V. Turner, you can find a chart that will show the variation in the percentage of braking power due to a variation in piston travel.

The chart in question shows a comparison of the effect of a brake application on a 4 in. and a 12 in. brake cylinder piston travel as compared with the standard 8 in. travel. 5-lb. brake pipe reduction gives 350 per cent. more braking power on the 4 in. travel than on the 8 in., and the 12 in. travel gives 150 per cent. less than the 8 in.

A 10-lb. reduction gives 125 per cent. more for the 4 in. travel than the 8 in., and the 12 in. 50 per cent. less than the 8.

Any further reduction gives a slightly less variation between the 8 and 12 in. travels, and produces equalization of

pressure on the 4 in. travel, after which the pressures and consequently the percentage of braking power can reasonably be expected to take a further drop due to back leakage into the brake pipe and possibly through other sources, so that at 20 lbs. reduction the percentage of braking power obtained on the long and short travel is still closer to that developed by the standard travel. You will understand that this table was only intended to show the undesirable effects of unequal piston travel, and must not be taken as a recommendation for a heavy initial brake pipe reduction, as there are other considerations that enter as factors in determining the amount of initial reduction that should be made in stopping a freight train.

STOPPING FREIGHT TRAINS.

J. B. L., Decatur, Ill., writes: In the March issue you stated how a mixed train of empty and loaded freight cars should be stopped with the air brake, if the loaded cars were ahead. How should the train be handled during a stop if the loads were behind the empties? A.—Having read that answer you understand that this is a matter largely governed by circumstances and local conditions, to say nothing about speed of train and the possible per cent. of grade the train may be descending, and naturally if rules could be formulated to cover all conditions of train braking, following the rules would require no reasoning, judgment or experience in successful train handling.

Taking your question as a general proposition, a train made up of 45 empties ahead and 20 loads behind would be a very nice train to handle from an air brake point of view; under those conditions you could expect the slack to run in when an application of the brake is made; therefore you would bunch the slack with a light application or a graduated application of the independent brake, then make an automatic application to conform to the majority of the types of triple valves in the train, that is, the lightest reduction that the triple valves will run through the train, and thereafter, with the slack all in, you can make most any kind of an application without doing any damage to the train.

POSITION OF BRAKE VALVE.

K. N., Wheeling, W. Va., writes: We recently had an accident on account of a No. 6 E. T. brake leaking off when the handle of the independent brake valve was in application position. A leak in the application cylinder pipe could not be tightened and it leaked away the pressure from the application cylinder faster than it could enter through the slow application port or than it could enter through the blow down timing port of the automatic valve in emergency position. What could be done to hold the engine under the circumstances?—A. The return spring casing screw can be removed from the side of the independent brake valve body and the valve handle would then remain in quick-application position. At the end of the trip the leak could be repaired and the screw replaced after removing the valve handle and cover and winding the spring in the return casing.

Want to Know.

An anxious inquirer wishes us to answer the following questions:

The real difference between iron and steel.

The proper composition of brass, and of babbitt metal.

What timber will sustain the heaviest load?

What timber is best adapted for immersion in water?

As there is some difference of opinion concerning the correct answer to these questions, we turn them over to the tender mercies of our readers. Give us your views.

Worse Than the Plagues of Egypt.

The opening of the Panama Canal will bring civilization into close touch with Central and South American countries whose conditions are very little known outside of their own borders. Considerable discussion was heard about the condition of the people engaged in the collection of rubber and they were said to exist in a state of slavery. That they exist at all is something surprising considering the hardships they must endure. We have seen accounts of pests in Africa written by railway locating engineers and others that must be worse than the plagues sent to torture the Egyptians, but we never heard of anything to equal the pests that prevail in the wilds of Bolivia and Brazil.

A short time ago an engineering party was appointed to survey the northern boundary between Brazil and Bolivia. The region embraces the head waters of the Amazon river, and is valuable to the world for the vast quantities of rubber collected by the natives. One of the surveying party, Lieutenant Edwards, in a report made to the Royal Geographical Society said that the plague of insects made the work very trying.

At one time they were away in the forest for 35 days, carrying out a journey of some 400 or 500 miles, and at its conclusion men and mules were in a pitiable plight, having been reduced to the last stages of exhaustion. In the forest and on the smaller rivers life was made almost unbearable by insect pests. Red ants, whose bite was like a touch from a red-hot iron; black ants, white-grey ants, yellow ants—each had its own particular way of making unwelcome the intruder into its habitat. Thought of discomfort was not usually associated with butterflies; but on the Rapirran there was a small brown variety which, during the hours of bright sunshine, would settle on the persons and instruments of the surveyors in such numbers and with such persistence that survey work became an impossibility. Every blade of grass had a tick of some sort waiting opportunity to bury itself in some one's flesh. There were mosquitoes, fever-bearing and otherwise, but all irritating; wasps of many colors, but always with a sting; hornets which gave no mercy to man or beast; bees of all sizes, some of which swarmed in eyes, hair, ears, mouth, and nostrils. There were flies, too, which deposited their eggs in the traveler's flesh, in which there afterwards hatched out a brood of maggots producing a very unpleasant carbuncle or ulcer. Vampire bats used to come out into the open spaces at dusk, and mules were particularly liable to attack, from these blood-suckers, which fastened on to the animals' throats and resisted all the poor beasts' efforts to dislodge them. Every river and stream was infested with jacaré (crocodile or alligator). Some of the smaller, yellow-colored ones were edible, the tail portion being very good indeed. Hunger—real, naked hunger—was an excellent sauce, and the explorer and voyager in those out-of-the-way parts often had a plentiful supply of it to add relish to the peculiar dishes to which he was reduced. Monkey, leopard, fox, tiger-cat, rat, snake, and crocodile had all figured in the Boundary Commission's bill of fare, while palm-tops and some species of grasses were by no means to be despised in lieu of vegetables.

AMONG THE RUBBER COLLECTORS.

The country through which the commission passed, said Lieutenant Edwards in conclusion, could not be looked upon as inhabited, but most of it had been more or less parcelled out into "seringals" or rubber concessions, and it was gradually being exploited in the interests of the rubber industry. The life of a working serengeiro was a particularly hard one. He often lived alone or with one companion in a rough hut or barraca built of lathes made from a species of palm and roofed with the leaves and fibres of another. Day in, day out, he lived the same sort of life, varied only by attacks of fever and rheumatism and by bouts of ptomaine poisoning caused by bad food. Occasionally he shot some animal or bird, but this was his only fresh food. Ill nourished, hard worked in a fever-haunted country, it was small wonder that the mortality among them was very high.

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Traveling Engineers' Convention.

The twenty-first annual convention of the traveling Engineers' Association, which was held in Chicago last month, was the most successful meeting held by that highly useful organization. The usefulness of the Traveling Engineers' Association seems to be thoroughly recognized, for within the twenty-one years of its existence it has grown from a membership of 47 in 1892 to over one thousand at present.

The association has been peculiarly fortunate in its choice of officers, C. B. Conger having been president for the first five years. That gentleman made promoting of the interest of the association a particular hobby, and as he traveled a great deal he acted as a special agent in inducing persons eligible to join the organization. He was succeeded by such men as D. R. McBain, P. H. Stack, C. H. Hogan, W. S. Wallace, David Meadows, R. D. Davis, J. D. Benjamin, A. L. Beardsley, W. J. Hurley, A. M. Bickel, J. A. Talty, C. F. Richardson, F. C. Thayer, W. C. Hayes, W. H. Corbett, and now F. P. Roesch. These are all names of men eminent in their calling and it was natural that the association should grow and prosper with such men at the helm.

But there is one not named as a presiding officer, whose influence has been almost supreme in working the association to its present condition of prosperity and usefulness. That is W. O. Thompson, who has been secretary from the beginning and is always in the front promoting work that will redound to the credit and glory of the Traveling Engineers' Association. Mr. Thompson is a sort of silent worker who moves without ostentation, but his labors are more and more in evidence as the years go by.

The committee reports were unusually interesting and directly represented the purpose and duty of the Traveling Engineers' Association, which is, "to improve the locomotive engine service of American railroads." The most positive and direct method of improving locomotive service is to increase the knowledge and skill of the men operating the locomotives. This is unusually well done in all the reports submitted, more particularly in that called "Uniform Instruction to Enginemen on Handling of Superheat Locomotives." We publish the greater part of that report in another portion of this paper, with a synopsis of the discussion thereon. We have never read anything more calculated to improve the practice of engineer and fireman in properly managing superheat locomotives than that report and we cordially recommend its study to the many persons who are trying to widen their knowledge on superheat.

On most of American railroads there has always been quiet conflict of authority between the operation and mechanical departments—not in what might be regarded as an aggravating form but sufficient to impair the efficiency of both departments and therefore detrimental to the best interests of the company. This subject is discussed in the report prepared by Messrs. M. J. Howley, J. B. Bowen, J. C. Petty, J. W. Nutting, G. H. Travis and P. J. Miller on "Credit due to operating department for Power Utilization and Train Movement that reduces consumption of fuel per ton mile." This report dwells upon the good that would result from increased co-operation between the two departments, more especially in the exercise of greater care in preventing engines waiting for trains after they have been fired up. We cordially recommend that the Traveling Engineers' Association make proper use of this report, by making certain that the leading operation officials are supplied with a copy. It makes interesting reading and may effect much saving grace.

A most seasonable report was made on "The care of Locomotive Brake Equipment on time of road and at terminals, also methods of locating and reporting defects." This is decidedly an educational report and urges the engineers to give more study to air brakes and to make themselves expert at effecting the minor repairs that are called for by brake failures on the road. The road foremen of engines are urged to impress upon the men under their supervision the necessity of familiarizing themselves with the details of brake mechanism. A variety of the most common defects are described and excellent instructions are given for the care of the air pump and other mechanism placed upon engines. This is another case where a copy of the report would do much good if placed in the hands of the men directly interested in the instructions given.

Le Grand Parish disseminates useful and valuable information in a paper on "Advantages obtained with the brick arch in Locomotive Service." Not only is the advantage of the brick arch clearly discussed, but all the appliances affecting construction and the free steaming of a locomotive. For enginemen no subject is more important than free steaming, therefore they should all be interested in this paper. Some very sensible remarks are made concerning the care of arch tubes. These tubes frequently fail with serious results and the failures are nearly always due through scale being permitted to form inside. Washing is not sufficient. The tubes must be freed from scale by mechanical cleaners. The paper forms an important contribution on the subject of free steaming and fuel economy subjects that are always with locomotive men.

"What can be done to eliminate the Black Smoke evil on Locomotives?" was the subject of an individual paper by Martin Whelan. The real text of the paper is in the question asked: Can the omission of black smoke from the stack of a locomotive be prevented, and how can it be done?

The merits of a variety of smoke preventing devices are discussed, among them the Crawford Stoker, which is said to be an efficient smoke preventer. After all, the conclusion reached by Mr. Whalen is that smoke prevention depends upon the care and intelligence of the engine crew. The highest perfected devices for smoke prevention will fail unless operated carefully by the engineer and fireman.

Air Brake Defense.

A man's knowledge of the air brake is often, either rightly or wrongly, judged by his ability to defend himself in time of trouble. There was a time when an air brake repairman who was quick witted and long on speech, could establish quite a reputation as an air brake man by being able to explain away trouble when it occurred. At the present time, however, master mechanics and general foremen look for results upon which to base their opinions as to the ability of their workmen, but in the air brake instruction room, or car, a man's ability to defend himself is still considered as a pretty fair indication of his air brake knowledge, in fact, an engineer is frequently censured more for his inability to put up a plausible excuse than for the offense he happens to be charged with.

This is in a measure as it should be, because the man who has had air brake trouble and can successfully defend himself before an air brake instructor, must have a very good general knowledge of the brake. Furthermore if a man has enough air brake knowledge to defend himself in time of trouble he will soon know how to apply his knowledge with the intent of avoiding trouble, and as a general proposition he is thereafter of very little annoyance to the air brake organization of the road he happens to be working for.

Frequently the argument put up to cover some phase of air brake trouble is very weak, or a good point of defense is misapplied. We have in mind a case where an attempt was made to locate the responsibility for an unusual number of torn out draw heads and broken couplings. This was very quickly found to be due to undesired quick action, then an effort was made to find the cause of the undesired quick action, the defense promptly took the stand that inasmuch as these cases of quick action were due principally to hard handling brake valves, it was entirely up to the engine house forces at the terminals to clean the valves and overcome the trouble. Instructions to cover the cleaning were promptly issued.

We can recall another instance in which an effort was made to locate the cause of some broken couplings and parted trains, which was said to be caused by some dirty distributing valves and dirty feed valves. This was accepted as just cause, but at the same time there was not a distributing valve with a quick action cap in freight service on that particular division to cause the alleged quick action, and no one was found who could explain in what manner a feed valve could make a brake pipe reduction, or contribute to undesired quick action and, moreover, use of lap position of the brake valve before the reduction was prevalent to such an extent that the feed valve was eliminated as a factor or a contributing cause regardless of its condition.

This line of defense, in this instance, made an apparently favorable impression, as some definite instructions concerning the condition of feed valves and distributing valves were issued for the benefit of the shop forces.

We can recall of other equally lame excuses that were put up and the parties having the excuse got away with it, and we have observed all kinds of efforts being made to find causes for undesired quick action when, or under conditions when brake pipe leakage taxed the capacity of the feed valve. Then instead of making a complaint concerning the leakage, or making any effort to remedy it, everybody cast about for some one of about 45 contributing causes of undesired quick action upon which to fasten the responsibility of the disorder.

In reference to brake pipe leakage, you may say that in handling a certain make up of train under a given condition, a certain number of pounds brake pipe reduction should be made for the initial reduction. Then if brake pipe leakage continues the reduction how is it possible to limit the reduction at the brake valve, or how can an engineer be held responsible for making a stop if brake pipe leakage makes it?

As to the liability of brake pipe leakage causing quick action, let us assume a brake pipe leak in the rear end of a long train. When the handle of the brake valve is placed in service position, the leak starts a brake pipe reduction and type K triple valves may temporarily assist, while the brake valve is starting another reduction at the head end, and at some point in the train the reductions must meet. They may meet at a point where a number of triple valves are not very sensitive to quick action and it may not occur even if the reduction is theoretically sufficient to produce it, but the reductions may meet near a perfect triple valve that has just passed the quick action test on the test rack, and it will respond as it was intended to and the brakes will go into quick action. If the train was then stopped and a test to locate the defective valve was conducted it is not likely that that "kicker" would ever be found.

Frequently we look for the cause of undesired quick action as we look for opportunity, we lament that it cannot be found, we travel from place to place in search of it, and behold it is constantly before us.

With all the air brake information that is in print at the present date, it is exceedingly difficult to convict an engineer, who studies the brake, of any incorrect practice, and it is sometimes difficult to convict a clever man of anything, regardless as to what he may be guilty of. We remember at a meeting called for the purpose of instructing the engineers and firemen in the art of economy in the use of fuel, the opening remarks were to the effect that the practice of using the coal sprinkling hose for the purpose of washing a half ton of coal out of the gangway on to the ground, would have to be discontinued and, in turning to the next recommendation, a momentary lull in the proceedings enabled an engineer to get the floor. He at once instituted a bitter complaint about having gone out the last trip with no drain cock in one of the main reservoirs, and about this time several more claimed to have had similar experiences in years gone by, and the meeting ended in this strain without any further discussion of economy in coal consumption, with the result that the air brake force was called in and informed that if another engine ever made a trip without a drain cock in one of the main reservoirs, someone's services were going to be dispensed with.

Nevertheless all of our great men have made mistakes, and the great air brake men have profited by theirs, and when a man has never made a mistake the chances are that he has never made anything else. Shortly after the type K triple valve came into general use a complaint was made to the Westinghouse Air Brake Company about a train in which the K valves were giving all kinds of trouble. The complaint was evidently made by wire, and as the train was still intact it was held until Mr. Turner could arrive on the scene and inspect the brakes. The subsequent inspection disclosed the fact that there was not a K triple valve in the train.

The Honeycomb Nuisance.

At the Traveling Engineers' Convention a long discussion was carried on concerning the honeycomb-like substance which is particularly troublesome to superheater tubes when certain coals are used. Detailed descriptions were given of how that substance was handled to overcome the obstruction it caused in tubes and the loss of heating surface due to the honeycombing. To our surprise nothing was said about the chemical nature of the coating and no remedy was suggested beyond certain ways of breaking off the adhering accumulations.

One time when the writer was running locomotives in Iowa he experienced much trouble from a clinker-like coating adhering to the back tube plate and other heating surfaces. He proceeded to analyze the stuff and found it consisted of the same elements as fire clay—principally silicate of alumina. As the substance contained no alkalis, the conclusion reached was that broken limestone mixed with the coal would act as an anti-

dote to the silicate. A few shovelfuls of broken limestone were thrown occasionally upon the fire and proved an effectual remedy. We recommend the people troubled by the honeycomb nuisance to try the limestone remedy.

Need of Compensation Laws.

Labor organizations cannot be said to neglect their own interests but they frequently waste much time, money and energy on promoting political measures which do little good, while things of far greater importance are ignored. This is particularly apparent in the small attention given to promoting compensation measures to give workers justice in the case of accidents due to the neglect of employers.

New York is a hot bed of rotten politics and workers' votes are numerous enough to elect men with some views about workmen's compensation and other beneficent measures, but they elect low down politicians whose last thought is for the real interests of their constituents. The recent holocaust at Binghamton brings up prominently the need for a fair compensation law in New York State.

The employers, who owned the firetrap factory in Binghamton, no doubt realizing the risk of disaster they were running, are reported to have carried liability insurance, the purpose of which is to fight claims for damages. That will probably mean a fight in the courts for each suit entered for damages. That means lawyers' fees, legal delays, and many vexatious developments, and in the end, means that none of the dependents of the dead, and none of the crippled is likely ever to gain adequate compensation. The crippled must go through life maimed and handicapped, possibly helpless and dependent, may even become inmates of county almshouses. Society suffers and individuals suffer.

The State of Ohio and several other States have fairly equitable compensation laws. Had the Binghamton tragedy happened in any of these States the injured people would have been cared for at the hospitals without expense to themselves, the best of surgical attendance would have been provided, there would have been allowance for expenses and at the end an adjustment commensurate with the injury suffered. For the dead there would have been funeral expenses allowed, and to those dependent on the victims there would have been an adjustment of compensation in the name of justice administered by the State.

There have been in different States disasters to workers similar, if less fatal than the Binghamton fire and all of them ought to act as object lessons to working voters to insist on the passage of laws for the protection of themselves and of their class.

Railroad Accounting by Machinery.

One of the great transcontinental railroads finds it necessary to refer repeatedly to traffic statistics in connection with rate litigation and kindred subjects. The volume of traffic on this road is such that complete reports of this character could not be obtained except at enormous cost in both time and money were it not for the fact that all traffic statistics are analyzed regularly by means of the punched card tabulating system.

This road reports the present plan of analysis to be so much more extensive and elaborate than before the tabulating machines were put in several years ago that no direct comparison can be made between present and previous costs of obtaining regular audits. It is estimated, however, that the present results in routine work without the aid of the machines would cost from 50 to 75 per cent. more than they now do.

But—under the old system they would not be in a position to answer the numerous requests for special information, called for by various officials and demanded in connection with rate litigation, without enormous cost. The cards adapt themselves readily to almost any kind of special information required, in addition to the regular tabulations. This makes additional information available on short notice—something practically impossible under any other system.

This road makes enormous use of the machines in routine work. Under traffic statistics statements are prepared showing tons, ton-miles and earnings by 88 different commodities for each of the fourteen states through which the line runs. Figures for interstate traffic are separated from those originating and ending in one state. Information called for by various state commissions and the Interstate Commerce Commission, relating to the classifications of tonnage are compiled in connection with these tabulations.

From freight train cards is produced a statement showing the various classes of ton miles by operating divisions, taking main lines and branch lines separately. This information is used in determining unit cost of operation. The cards are used also for compiling gross ton-miles by each individual locomotive, these figures giving ultimately unit costs and comparisons between separate locomotives and also as to various classes of locomotives.

In this way information is obtained which determines in a measure the policy of the company with regard to types of locomotives ordered. Those types which show excessively high cost for their work are not repeated. In many cases it is possible by combining certain characteristics of different types to reach that one which is, everything considered, best suited to the work in hand.

Odious Comparisons.

In the early days of The Traveling Engineers' Association, some of the members labored hard to establish hard and fast rules about the quantity of supplies, especially oil, that might be used with certain trains. A compromise of diverse opinions was made in a resolution being carried, which read: "In the opinion of the association, there is no reliable comparison between roads as to the use of oil per mile run. Each engineer must make his time and be allowed to use some judgment in the use of his supplies. We believe that the standard of comparison should be the monthly average of the best half of the runners on a division. This makes allowance for local conditions, climate, engines, water and the difference in oil."

This resolution carried strong influence and stopped in some quarters the tendency to make unfair comparisons between different roads and different divisions. It would stand application to some questions in dispute today.

Attempts to Emasculate the Parcels Post Law.

After more than forty years of agitation the American people succeeded in securing a parcels post law, and its working has indicated that it is one of the most substantial helps that the mass of our population has ever obtained. We find, however, that the powerful influences entrenched in the express companies and in the United States Senate are laboring hard to rob the parcels post of its most valuable features. The limit of weight carried originally by the parcels post was eleven pounds, which was found to be too low. Postmaster General Burleson recently revised the parcel post regulations in favor of the shipper and increased the limit from eleven to twenty pounds. An agitation was at once started among certain money interests to prevent any more changes from being made that would benefit the masses who use this means of obtaining goods and supplies at low cost.

Senator Bryan, of Florida, introduced a resolution into the Senate which, if carried, will emasculate the Parcels Post Law. The change, if effected, will remove from the Postmaster General the power to raise or lower rates, putting that power into the hands of Congress. Every workman who reads this paper is interested in the parcels post law remaining intact as it was framed, and we advise them to use their

influence with their representatives to see that no change is made.

New Haven Engineers.

Some years ago the New York, New Haven & Hartford Railroad Company made an agreement with its locomotive engineers that seniority should rule in the promotion of all enginemen. There had been complaints that favoritism was much more influential in the advancement of enginemen than merit or length of service and the Brotherhood of Engineers threw their great influence on the side of those who were seeking fair dealing.

The officials of the company now hold that the Stamford collision was caused by an incompetent engineer who was assigned to the express passenger engine in compliance with the rule of seniority and they have given notice that the rule will be abrogated at the end of thirty days. The enginemen are strenuously opposed to any change and a conflict between the company and their locomotive engineers seems to be impending. Chief Engineer Stone is looking after the interests of the engineers and we have no doubt that an equitable settlement will be agreed upon.

College Men for Railroad Work.

The selection of Mr. Howard Elliott, a college-trained man, to be head of the New York, New Haven & Hartford Railroad has again aroused the time-worn controversy: "What is the college man's place in railroad service and why is his training so seldom utilized in that line of business?"

In a recent issue the editor of the *Literary Digest* publishes opinions of influential railroad officials on "College Men for Railroad Work," but nothing of practical value is brought out. One high authority is quoted as believing that college professors are long in theory and short in practice, while another person whose views are considered important holds, that railroad officials are long in practice and short in theory. From a wide and varied experience we believe what is most needed to make a successful railroad official is good sense and readiness to do hard work. These two attributes have formed the foundation of the success of most of our prominent railroad men today. A college education is likely to be a powerful lever in raising a man upward if properly used; but the time spent at college may be used to better advantage in learning the details of railroad work.

College professors, the promoters of so-called higher education, have always done their best to open the road for college graduates into every line of business that pays well. For this reason agitations have been carried on favoring the giving of railroad positions to college graduates. Not minor positions when hard work would be encountered to supplement college instruction; but high-up jobs entailing little work and initiative glory. At one time when a periodic movement was actively in operation to fill railroad soft jobs with college graduates, an unusually active youth was placed in the hands of Mr. J. D. Besler, general superintendent of the Burlington. This youth was not contented to hang about and draw his pay regularly. He kept boring Mr. Besler for work, and one day began outlining improvements which he considered ought to be carried out. "Well, now, Mr. Stone," remarked Mr. Besler, "this railroad is running all right, and my advice to you is don't stop it unless you know how to start it again."

College graduates have done fairly well in railway service, but the successes are offset by numerous failures. Mr. Ivy L. Lee, executive assistant of the Pennsylvania Railroad, says that technical graduates are different in three general particulars:

"First, lack of practical experience and judgment,

"Second, an idea that they are far superior to the rest of mankind,

"Third, a certain narrowness of mind, inculcated through a too exclusive attention in college to mathematical and theoretical science, and a too great neglect of broader subjects such as political economy, history and general literature."

The college professors are tortured with the idea that railroad life is suffering for want of greater admixture of college graduates, which is a blunder of ignorance. The average railroad man has received a good common school education which forms a sound foundation for all the knowledge the highest-class of railroad man requires. The industry and perseverance that have made railroad leaders of the past figure as educated gentlemen, are still in operation and will continue to produce like results. Many prominent railroad officials have been required of late years to give evidence before "investigating courts." Among these officials have been not a few college graduates, and none of them displayed the ability to describe business conditions and to discuss abstruse, transportation and industrial problems, as did Daniel Willard, president of the Baltimore & Ohio, and John C. Stuart, vice-president of the Erie, neither being a college graduate. The conditions which trained Messrs. Willard and Stuart are still active, and may be depended upon to produce similar men should no college graduate ever enter the railroad ranks.

Speed and Danger.

When an accident happens to any of our express trains known as "flyers," there is always more or less protest from the public; yet we are ever assured by the officials responsible for the running of such trains, that it is done to meet the public demand. This statement has been reiterated so often that people accept it as being true when it is false without any real foundation. In the interesting letter from George Westinghouse, which we publish elsewhere, mention is made of a railway manager who never traveled on the eighteen-hour trains. That manager knew perfectly well that the inordinately fast trains were not run to meet a public demand, but because they made an excellent advertisement for the company running the trains.

At a recent meeting of the International Travel Club, Secretary Elliott drew attention to the fact that when several of our leading railways lengthened the running time of their exceptionally fast trains they received only commendation from the public, which may always be depended upon to favor safety in preference to speed.

The same principle applies to the supposed demand for high speed ocean steamers. The high speed and the luxurious furnishing of modern ocean steamers are reported to be provided to meet the demands of the public; but they are really supplied to form magnificent advertisements. The great expense involved in providing Roman baths, gymnasiums and restaurants of stately expanse and gorgeous decorations, would be better spent in facilitating the navigation and increasing the safety of these enormous vessels, but then measures of safety are not as imposing as Roman baths and pneumatic elevators.

Criticism and Electricty.

There are two ways of looking at a modern locomotive. One way is to extol its might and picture the amazement of our great-grandfathers if they could see such a contrivance. The other way is that adopted by a man who recently declared, "For units of service derived from a ton of coal, a steam locomotive is the most wasteful machine ever invented."

He was discussing the contract let by the St. Paul road for electrical operation of four hundred and fifty miles of main track crossing three mountain ranges in Montana and Idaho. The cost of electrical power, it is said, will be only a third that of steam, and the eight million dollars spent by the road installing the new system will be recovered in five years through saving in operating experiences.

The current, of course, will be derived from water-power that has been going to waste from time immemorial. Water-power is abundant in Montana and current can be generated from it cheaply.

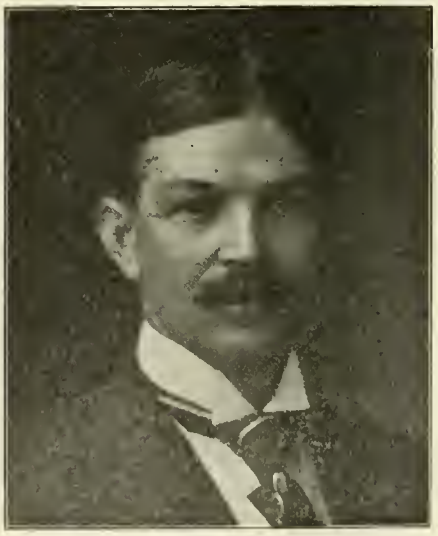
General Foremen's Department

Mr. F. W. Thomas On Apprentices.

When the report on Apprenticeship had been read at the General Foremen's Convention, Mr. F. W. Thomas, Supervisor of Apprentices of the Santa Fe System, said:

While all of the railroads included in the report and also the manufacturing or commercial concerns, show a determined spirit to give the boy in their employ the best opportunity possible to learn his trade, it is a further evidence of a necessity which the times has demanded. The modern shop offers little chance for a boy without some one to guide and direct. The foreman and the gang foreman, are too busy and have too many other duties to perform to be bothered with green boys. A boy floundering around a big modern shop four years with no kindly hand to help or direct him, is what gave the old apprentice system the black eye, from 1890 to 1905. He was a failure for at the end of four years he knew next to nothing of the trade. The old hand passed away in his natural course of years. There was no trained man to take his place. That is why you suffered such a dearth of first class mechanics. That is what drove you to the specialist, the handyman, a man who could successfully run one machine but none other. The rapid growth of this country, the great increase of manufacturing plants, the increase in railroad shops, the great auto factories and garages, all demanding mechanics, a demand many times over the supply. You often point out some old man in your shop as being a fine first-class mechanic; he served his time years ago when serving was good. When the foreman had the time, the patience, the fatherly interest in the boy, he was given a good opportunity, he progressed and he loves the work. You point out others who are often called boomers. You speak of your pick ups. You picked up a man off the street and put him on a bolt cutter and a bolt cutter he is today. You picked another from the slums and put him on a boring mill and a boring mill hand he is today, and no more. You picked another from the farm and put him driving rivets and a rivet driver he is today. You picked another from the wharf and put him running a forging machine and a machine forger he is today. What will the bolt cutter do when there are no bolts to cut? These leave you and go elsewhere, hiring out as machinists.

The Santa Fe Railway said to the general foremen and foremen: "We know you haven't the time to pay much attention to these boys; you look out for the output of the shop and your other duties, and we will put a man there whose sole duties will be to look out for the apprentices, responsible to you for the boy's progress and work. He will move them from machine to machine, from job to job, showing them step by step, and then we will have a schoolroom, the boy will be taught by another instructor such subjects as he needs in his trade, receiving the mental training along with the practical." With the present system we have found the boy with the assistance of his shop instructor becomes productive at once. No time is lost in experimenting, and finding his place, or getting over his stage fright. He is made productive at once. In the absence of a regular man on any machine, our foreman simply says to the shop instructor, "Put one of your boys on that machine while Joe Smith is off." He does it, and stays with him enough to insure a reasonable day's output. The success we have attained with our apprentices has been due to the full, ample shop instruction. We appoint the best men we have and enough of them to insure the boys complete instruction. I believe with Mr. Basford, that the present shops need more instructors and fewer inspectors. We have an assistant vice-president on our road, one who was reared on the road, who is now in his forties, and every day of his life since he was fifteen, has been spent in her service. Serving his apprenticeship he was gang foreman before he was out of his teens, and was promoted through the entire line step by step. He had none of these present day advantages, was denied the advantage of an early education, but possessed with an abundance of unerring. common sense, he is at one and the same time a leader, a driver, a worker, and a friend. Recognizing the advantages such an education gives a boy learning his trade, he established a night school for his apprentices, rented a room and employed an instructor from his own pockets. This is the first railroad apprentice school of which I have any knowledge and it was fifteen years ago. It must be a source of some pleasure and graitfication and recompense for his labor and expense that over half of these boys are now occupying some official position on the railroad. As to the value of shop instructors he wrote a mechanical superintendent in reference to putting on an additional shop instructor saying, "A good shop instructor is worth $350 per month in any shop and there should be one for every twenty-five boys."



FRANK W. THOMAS.

We are not trying to make mechanical engineers; the colleges furnish these. We are not trying to make draftsmen; the schools furnish these. We want to make first-class skilled mechanics to operate our machines, men who are trained and educated in our ways, our methods, our standards, whose home and family ties are within our midst. We are making them the equal to any on earth, good mechanics, good citizens, proud of their work, and their road, and the apprentice system which has made their present condition possible.

Mr. Thomas' remarks were received with much favor by the members of the association, and his views, after being favorably commented upon, were unanimously approved.

Preserving the Polish of Tools

Condensation of moisture on the surface is what takes the polish off tools and makes iron rust. Preventing it is simply a matter of keeping the surface coated with some varnish, resinous or oil substance. If tools are carefully cleaned every night, and then gone over with an oily rag, they should keep in very good shape; that is, if they are in use every day so that the oily coating has a frequent renewing. A heavier coating for tools that are to be put away for some time, can be made by melting together 7 parts of tallow and 1 of resin. Apply in a half liquid state.

REPAIRS TO LOCOMOTIVE APPLIANCES

By WM. HALL, Gen. Foreman C. & N. W. Ry., Winona, Minn.

That much time and money can be saved in the repairs of small locomotive appliances, is without question.

By small locomotive appliances, is meant, air pumps, lubricators, injectors, boiler checks, gauge cocks, pop-valves, motors for electric headlights, etc. This work should be specialized, and all done in one department, as much as possible, with a sufficient force to handle it economically, or in other words, concentrate it at headquarters for each division, creating a distinct department for this class of work alone; and not have it done at any two-by-four round-house, in a haphazard way, where skilled help is oftentimes an unknown quantity.

Time savers are money savers, therefore tools and jigs should be devised for doing special kinds of work, and used in every instance where duplicate parts are required; good fitting wrenches for the removal of parts should be kept on hand; for instance, where spanner nuts are employed, a good stout and short spanner wrench should be used, one that would be stout enough to receive a sharp blow with a hammer, to loosen the nut, thus doing away with the set, or more often the chisel, which not only mars and distorts the nuts, but also has a great tendency to spread them; but a short spanner wrench, such as I have mentioned, would loosen the nut without either marring or spreading it.

All, or most, parts of the above-mentioned equipment, are of delicate construction; in a great many cases it is faulty design, in other cases a chance to save a little metal, which is often carried to excess and to the detriment of the finished article.

Little thought is given when designing parts to the time when these will come in for repairs, or to the little time at the disposal of the round-house man. A new article looks good, goes together with ease, joints will face up good and will not leak, but after a time these become so tight from heat and corrosion, they seem to be burned together, and it is almost impossible to separate them without marring or distorting, for the simple reason that there is very little or no room for a wrench to take hold; this is caused by the false economy of saving a little metal; I see dozens of such like cases.

I believe that parts of locomotive equipment should not be removed any oftener than is absolutely necessary; this is often done in the case of pumps, injectors, pops, etc., to satisfy the whim of some engineer, and when I say this I know whereof I am talking, and can cite case after case if called upon; this is absolutely wrong, for every time a joint is broken, or separated, there is the fear of a leaky joint, when replaced; the nuts are spread more or less, and in a short time become so loose they must be renewed.

That is why I state that the work should be done by competent men, and that good and suitable tools should be provided.

Then again, tools designed for this or other specific work should be kept for this work exclusively, and for the men doing this special kind of work, and not used by everyone.

Tools should be assigned a place in the tool room of the department to which it belongs, and not hid away in some dark corner, or thrown under the benches; here is where considerable time is lost in hunting up a tool, hid away or placed under benches and covered over with a dozen other tools, instead of being on a rack in the open, where one can see at a glance the one tool required.

I am fully alive to the fact that in some engine houses there is not sufficient work to keep a high-priced man, for at such places a man is required only who can grind in a check valve, replace some broken pipe fitting, etc., but even that difficulty is overcome these days by a new make of valve now on the market, that requires no skilled help, simply an old file or straight piece of iron and a monkey wrench, to make the parts affected almost equal to new in its efficiency, and this without refacing or regrinding, a great boon to the roundhouse man, a great time and money saver.

It seems to me while so much attention is being given to the standardization and interchange of parts, that it would be a paying proposition if some of this time was given to standardizing of tools for doing certain repairs, also standardize the repairs themselves; today each man has his own ideas as to ways of doing the work, also the tools he should use; the result is not very gratifying.

Any device for expediting work, or performing that work, with the highest amount of efficiency, should, after having passed the experimental stage, and proved to be good, be required to be reported to headquarters, where blue prints should be made and sent out with instructions to have made and installed, or, better still, have the device made at headquarters and sent out with positive instructions to be placed in commission, to replace older and obsolete methods. This would not only systematize matters, but bring these tools and methods to a standard.

The way matters stand now, a man will devise a very efficient tool, which is used all over the system, or at such points where these repairs are made, would prove to be a great money saver; but no, he is somewhat jealous of his knowledge, and does not want the other fellow to share it with him, but sometimes these things are stumbled upon accidentally, then if the fellow doing the stumbling act is a live wire, he requests a blue print of this or that tool, and reaps the benefit of it. For instance, the writer while attending a recent convention stumbled across a better method of performing part of his work. A blue print was obtained, and am now using the other fellow's idea with advantage to the company.

A small lathe, small drill press, and shaper, are indispensable to a department if this kind, not only to save many steps to and from the shop tools, but would save time in many ways.

I believe that it would pay the railroads if they would place one or more traveling demonstrators on their systems, whose duty it would be to go from one shop to another and see that locomotive repairs are made according to the adopted standard way of doing them, and also see that proper tools are used in making these repairs; or if this is not thought feasible, have printed instructions sent out to all shops, where they should be hung in some conspicuous place, and not where they will become oil bespattered and then are neither useful nor ornamental.

It goes without saying that a department of this kind should be under a competent head, one who would see that all this class of work was done in a first-class manner, one that should be the judge as to whether any part of the equipment should be removed or not; in fact, all of this class of work should come under his direct supervision.

Durability of Ties.

The average life of untreated ties as reported by the steam roads is as follows: Cedar, 9 years; tamarack, 8 years, hemlock, 7 years; Douglas fir, 7 years; jack pine, 6 years; spruce, 6 years. As recent statistics bear evidence, cedar is the species principally used, because of its durability, but the supply of cedar is rapidly becoming exhausted. Unless preservative treatment of ties is introduced, the short-lived species will have to be used untreated, which, on account of the necessary frequent renewal, will increase the cost of mileage maintenance. If treated ties were used, which would cost 30 cents extra per tie for creosoting and equipping with tie plates, the inferior species, which are very plentiful and cheap in Canada, could be used with economy.

With such a treatment, these woods would last at least 15 years, and if protected from wear would probably last much longer, and would effect a very considerable saving.

Air Brake Department

Cross Compound Compressors.

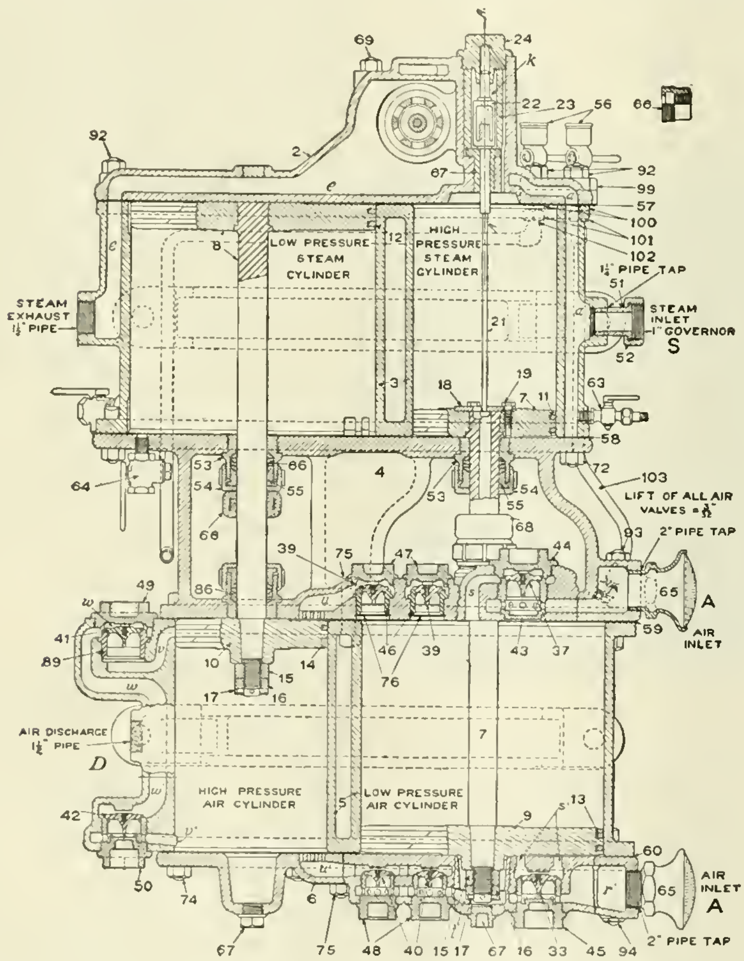
Locating the source of trouble in, and making repairs to the cross compound compressors, is somewhat more difficult than with the single stage compressors, principally on account of more and heavier parts.

However, the cross compound compressor has now reached a state of perfection that enables it to run from one time of overhauling to another with no more, if as much, trouble as the smaller pump. A great deal of trouble was experienced with the first type of compound compressor, due to a considerable friction producing main valve area and when lubrication became scant or when the steam pressure fell down to less than 150 pounds., the pump had a tendency to stop working.

Another trouble was from air valves breaking and pieces falling back into the air cylinders, and if the pieces were of any considerable size the compressor would not operate until they were removed, which involved a removal of the air piston from one of the cylinders, sometimes both.

The slide valves are now replaced with a piston valve with five sets of piston rings and the oil tempered air valves replace the old styles for all pumps, and those two troubles are entirely eliminated, but even if an air valve in the center piece should break, the openings to the valves are in a perforated form so that a broken piece of valve cannot enter the cylinders.

There is still some occasional trouble from a broken piston rod, but a new style of taper fit of the piston on the rod is giving better results, and if certain kinds of steel were eliminated, and if more care was exercised in the selection of material for welding those rods in the repair shops, this trouble might entirely disappear or at least be reduced to a rare occurrence.



8½-INCH CROSS COMPOUND COMPRESSOR—VERTICAL SECTION.

By cross compound it is meant that the high pressure steam piston is attached to the low pressure air piston and that the low pressure steam piston is attached to the high pressure air piston. The high pressure steam piston operates the reversing gear in the same manner as in other Westinghouse pumps. A valve rod extends into the hollow piston rod and is moved by the usual reversing plate alternately coming in contact with a shoulder and a button on the rod.

The outside of the small end of the piston valve is at all times open to the exhaust port of the steam cylinders. The outside of the large end of the piston valve is opened to the exhaust by the reversing valve, when the high pressure steam piston is on the upstroke and the outside of this piston receives steam from the boiler by the way of the reversing valve to balance the steam pressure on both sides of it and permit the small end of the piston valve to move the structure to the position necessary for the down stroke of the high pressure steam piston.

The central row of ports in the main valve bushing lead to the exhaust, and in either position of the piston valve, one end of the low pressure steam cylinder is opened to the exhaust pipe and atmosphere.

The duty of the high pressure steam piston is to move the low pressure air piston and impart the movement to the reversing valve rod, the duty of the reversing valve rod is to actuate the reversing slide valve, the duty of the reversing slide valve is to admit steam to, and exhaust steam from, the chamber in which the large end of the piston valve operates, which permits of the operation of the piston valve. The duty of the piston valve is to distribute the steam to, and exhaust it from both ends of both steam cylinders.

The low pressure steam cylinder receives its steam from the exhaust of the high pressure cylinder, which in combination with the compression from the low pressure air cylinder, accomplishes the positive movement of the high pressure air piston.

When the pump throttle is opened, steam from the boiler enters the main valve bushing and is always effective on the reversing slide valve and on the inside faces of the largest and smallest pistons of the piston valve structure.

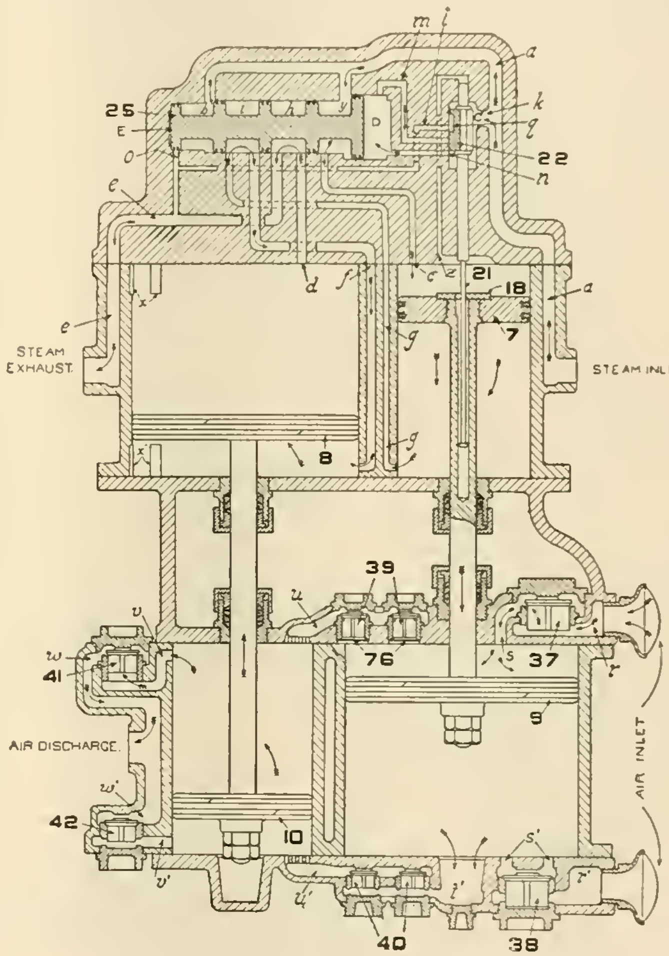
The direction the piston valve will move depends upon the position of the

reversing valve, if the high pressure piston is at the bottom end of its stroke, as it probably will be, the reversing valve will be held in its lower position in the bushing and the steam port leading to the outside of the large main valve piston will be closed and the exhaust port will be open, hence the greater area of the piston valve that remains exposed to steam pressure will cause this structure to move in the direction of the large end, and steam pressure will be admitted to the under side of the high pressure steam piston, and start it on its upward stroke.

Referring to the large piston of the main valve as No. 1, and the next as Nos. 2, 3 and 4, and the small one as No. 5, each fitted with two steam tight packing rings, live steam from the boiler is always present between sets of rings No. 1 and 2 and between pistons 4 and 5, and when the valve is in the position described, steam from between pistons 4 and 5 flows through suitable ports in the bushing to the under side of the high pressure steam piston. At this time the upper end of the high pressure steam cylinder is connected with the upper end of the low pressure steam cylinder through the cavities between pistons 2 and 3, while the lower end of the low pressure cylinder is open to the exhaust pipe between pistons 3 and 4.

When the high pressure steam piston nears the upper end of its stroke, or if the high pressure piston has remained at the upper end of its stroke when steam was turned on from the boiler, the reversing plate engaging the shoulder on the valve rod moves the reversing valve or either holds it in its upper position in the bushing, and the outside of the large end of the piston valve will receive steam which balances the pressure and the steam pressure effective on the inside of the small piston will move the structure toward or in the direction of the small piston and at this time the port leading to the top of the high pressure steam cylinder will be opened to receive live steam from between pistons 1 and 2, while the lower ends of the steam cylinders are connected betwen pistons 3 and 4, and the upper end of the low pressure cylinder is open to the exhaust pipe between pistons 2 and 3. If for any reason the main steam piston should move before the main valve structure when the steam is first turned on, the operation mentioned might be reversed, that is, the reversing valve might be moved out of its original position before the main valve could move, but when the steam piston stops the distribution of steam takes place as explained.

After a stroke or two of the high pressure steam piston and the closing of the drain cocks, the low pressure steam piston starts into action, both pistons moving at the same time but in opposite directions. The steam pistons of the 8½ pump are 8½ and 14½ inches in diameter, and the air pistons 14½ and 9 inches, the high pressure steam piston being 8½ and the high pressure air piston 9. There are 4 receiving valves, standard 29177 for the 11-inch pump, 4 intermediate valves 24396 of 9½-inch pump, and 2 final discharge valves standard for the 11-inch pump. The discharge valves are screwed into the air cylinders, the rest of the valves are located in the center piece and in the lower head, the upper valves work on seats and the lower ones in the usual brass cages.



COMPRESSOR ON DOWN STROKE.

There is practically no clearance whatever for either air piston in its cylinder, and the length of stroke is but slightly altered by working against a high air pressure, as the low pressure piston compresses air pressure to about 40 pounds, the location of the air valves permits of the minimum amount of "dead space" from which air cannot be compressed, hence this compressor has a very high rate of efficiency, compressing about 85 per cent. of a low pressure air cylinder full of free air on each stroke. This combination of using the steam twice and incidentally utilizing the back pressure from the high pressure steam cylinder, as well as the compression from the low pressure air cylinder, to operate the high pressure air piston, gives the pump a little over three times the capacity of the 9½-inch pump and requires about one-third the amount of steam in compressing a predetermined volume of free air to a certain pressure.

The lift of the air valves is 3/32 of an inch.

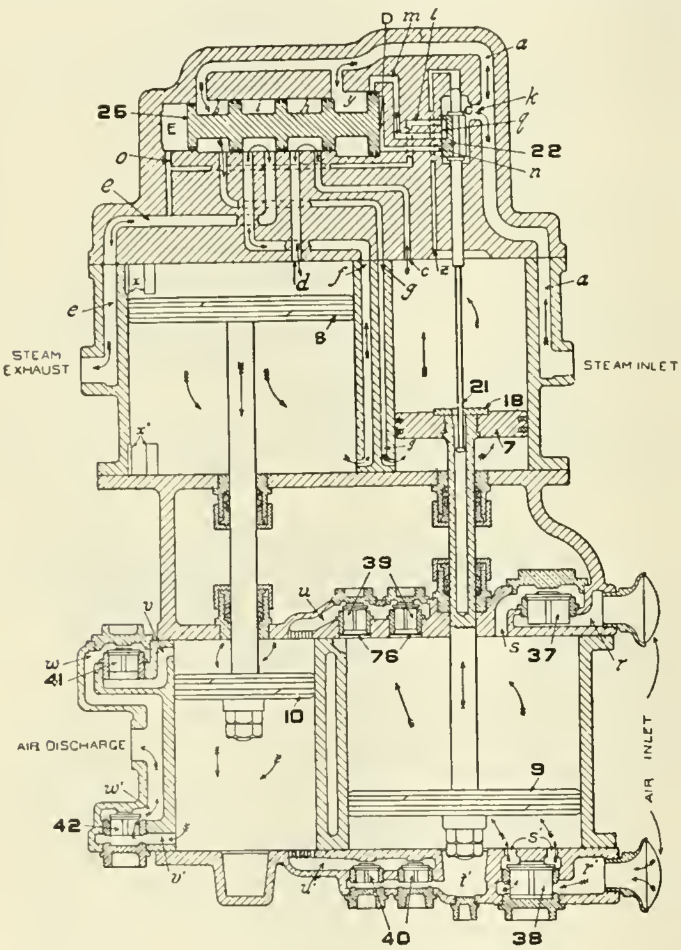
The use of compressed air in industrial fields has been so widely extended that the Westinghouse Company has for this purpose developed a 10½-inch cross compound compressor, which operates as explained in connection with the 8½ pump. It is designed to operate on a relatively low steam pressure and requires a lower differential between steam and air pressures, and while intended for fugitive work it is finding its way into railroad service.

The actual differences between the two compressors are more readily shown in the following tables:

8½ C. C. COMPRESSOR.

Diameter of H.P. steam cylinder	8½ ins.
Diameter of L.P. steam cylinder	14½ ins.

Diameter of H.P. air cylinder	9 ins.
Diameter of L.P. air cylinder	14½ ins.
Length of stroke	12 ins.
Governor	1¼ in.
Diameter of steam admission pipe	1¼ in.
Diameter of steam exhaust pipe	1½ in.
Diameter of air admission pipe	2 ins.
Diameter of air delivery pipe	1½ in.
Designed for a steam pressure of	200 lbs.
Working against an air pressure of	140 lbs.
Normal speed, single strokes per min. above conditions	131



COMPRESSOR ON UP STROKE.

Displacement, cu. ft. per min. under above conditions	150
Over all dimensions (approximately)—	
Height	52 ins.
Width	37 ins.
Depth	18⅛ ins.
Average net weight	1,500 lbs.
Weight boxed for shipment	1,750 lbs.
Lift of air valves	3/32 in.

10½ C. C. COMPRESSOR.

Diameter of H.P. steam cylinder	10½ ins.
Diameter of L.P. steam cylinder	16¾ ins.
Diameter of H.P. air cylinder	9½ ins.
Diameter of L.P. air cylinder	14½ ins.
Length of stroke	12 ins.
Governor	1½ in.
Diameter of steam admission pipe	1½ in.
Diameter of steam exhaust pipe	2½ ins.
Diameter of air admission pipe	2½ ins.
Diameter of air delivery pipe	1½ in.
Designed for a steam pressure of	100 lbs.
Working against an air pressure of	80 lbs.
Normal speed, single strokes per min. conditions cited	131
Displacement, cu. ft. per min. under same conditions	150
Over all dimensions (approximately)—	
Height	51⅞ ins.
Width	41⅞ ins.
Depth	21 ins.
Average net weight	1,800 lbs.
Weight boxed for shipment	2,150 lbs.
Lift of air valves—	
Intermediate	⅛ in.
Suction	5/32 in.
Discharge	5/32 in.

In referring briefly to the possible disorders of this type of compressor, the stopping in service, overheating, pounding and uneven strokes are caused by the same breakages and disorders that affect the single phase compressors, and to give a detailed account would be in the nature of a repetition of the troubles usually found in the 9½ and 11-inch pumps, but a little more observation is necessary to locate the broken or stuck air valve in the compound pump.

Low pressure packing ring leakage in the air cylinders can be detected by noting the amount of air drawn in at the strainers, while high pressure packing ring leakage is not so readily noted, but if it is very serious it will materially affect the efficiency of the machine and tend to reduce its speed.

Packing ring leakage is always a serious matter, as well as any leakage to the atmosphere from the air cylinder, as it is almost sure to cause overheating and its attending evils, the leakage from the stuffing boxes, not only decreases the amount of air delivered, but by requiring a faster speed to keep up the pressure, increases the heating and causes pounding. We have noted numerous cases in which the loss of cushion, due to stuffing box leakage, resulted in the breaking off of the air piston from the steam piston and rod. The fact of the matter is that an overheated air pump is liable to break down at any moment and without any warning.

It is also well to pay particular attention to any unusual click or pound that may develop; if the pump is tight on the bracket and the pound continues, it indicates that the air valves require some attention or that the pump has a loose piston or a loose reversing plate bolt or that there is possibly a broken piece of one of the pistons in one of the cylinders.

As stated before, there is not much opportunity for a piece of a broken air valve to enter the cylinders.

In dealing with this type of compressor the air brake man should bear in mind that in every phase of air brake practice the most serious disorders and the most mystifying troubles are the most manifest and the easiest remedied when they are finally located, and the dirty and partly closed air pump strainer, the cleaning of which is probably the simplest piece of repair work which can be done on a compressor, is undoubtedly at the bottom of more air brake disorders and air pump failures than any other known cause.

Second only to this is the lack of lubrication in the air cylinder; it is indeed difficult to keep a compressor in good condition and well lubricated, from running warmer than the natural degree of heat generated during, or incident to, compression and if the cylinder is not properly lubricated at intervals as frequent as may be necessary, it is impossible to keep the compressor from what is termed running hot.

Size of Equipment and Recommended Braking Power.

Inasmuch as many of our readers do not have a ready access to the standard catalogues of the air brake companies, we have arranged, in a tabulated form, some information concerning the proper sizes of triple valves, auxiliary reservoirs, supplementary reservoirs and the recommended practice as to braking power, as decided upon by the Westinghouse Air Brake Company.

This is all the more necessary because a careful study of these tabulations will give much ready information bearing upon conditions that are not generally understood, and up to the present time have not yet found a place in the instruction books published in regard to the details of air brake equipment, although appearing in some of the recent catalogues.

Following are the recommendations for the percentage of braking power calculated to give the best results. This is figured for 50 lbs. cylinder pressure with all types of equipments—plain and quick action triple valves and E.T. engine and tender equipments—and for a total leverage not to exceed 9 to 1.

Class of Service.	Type of Equipment.	Braking Power.
Driver brakes	Old standard (A-1)	75%
Driver brakes	No. 6 E.T.	60%
Engine truck	Old standard (D-2)	60%
Engine truck	No. 6 E.T.	45%
Trailer brake	Old standard (D-2)	60%
Trailer brake	No. 6 E.T.	45%
Tender brakes	With Q.A. triple valve	85%
Tender brakes	With plain triple valve	100%
Tender brakes	With No. 6 E.T.	80%
Passenger car brakes	Type P triple valves	80%
Passenger car brakes	Type L triple valves	80%
Passenger car brakes	With supplementary reservoirs	90%
Freight car brakes	All types	60%

PISTON TRAVEL.

Driver brake, two cylinders	4 ins.
Truck brake	6 ins.
Tender and car brakes	8 ins.

STYLE OF DRIVER BRAKE TRIPLE VALVE AND SIZE OF RESERVOIR.

Size of Cylinder.	Triple Valve.	Auxiliary Reservoir.
8 inch	F 1	10 x 33
10 inch	F 1	12 x 33
12 inch	F 2	14 x 33
14 inch	F 2	16 x 33
16 inch	F 2	16 x 42
18 inch	F 2	16 x 48

TRUCK BRAKE

6 inch	Driver brake triple valve	10 x 14½
8 inch		10 x 20
10 inch		10 x 28
12 inch		12 x 27

TENDERS, PASSENGER OR FREIGHT, QUICK ACTION TRIPLE VALVE.

Cylinder.	Weight.	Triple.	Auxiliary Reservoir.
8 x 12	15,000 to 26,000	H 1	10 x 24
10 x 12	26,000 to 41,000	P 1	12 x 27
12 x 12	41,000 to 59,000	P 2	12 x 33
14 x 12	59,000 to 81,000	P 2	14 x 33
16 x 12	81,000 to 106,000	P 2	16 x 33

TENDERS, FREIGHT, WITH PLAIN TRIPLE VALVE.

Cylinder.	Weight.	Triple.	Auxiliary Reservoir.
8 x 12	15,000 to 22,000	F 1	10 x 24
10 x 12	22,000 to 35,000	F 1	12 x 27
12 x 12	35,000 to 50,000	F 2	12 x 33
14 x 12	50,000 to 69,000	F 2	14 x 33
16 x 12	69,000 to 90,000	F 2	16 x 33

ALL CLASSES E.T. EQUIPMENT.

Cylinder.	Weight.	
8 x 12	15,000 to 28,000	NONE
10 x 12	28,000 to 44,000	
12 x 12	44,000 to 63,000	
14 x 12	63,000 to 86,000	
16 x 12	86,000 to 113,000	

PASSENGER CARS.

Cylinder.	Weight.	Triple.	Auxiliary.
8 inch	16,000 to 28,000	P 1	10 x 24
10 inch	28,000 to 44,000	P 1 or L 1	12 x 27
12 inch	44,000 to 63,000	P 2 or L 2	12 x 33
14 inch	63,000 to 86,000	P 2 or L 2	14 x 33
16 inch	86,000 to 113,000	P 2 or L 3	16 x 33
18 inch	113,000 to 143,000	L 3	16 x 42

WITH SUPPLEMENTARY RESERVOIRS.

Cylinder:	Weight.	Triple.	Supplementary.
8 inch	16,000 to 25,000	L 1	14 x 33
10 inch	25,000 to 39,000	L 1	16 x 33
12 inch	39,000 to 56,000	L 2	16 x 48
14 inch	56,000 to 77,000	L 2	20½ x 36
16 inch	77,000 to 100,000	L 3	20½ x 48
18 inch	100,000 to 127,000	L 3	22½ x 54

CAPACITY OF RESERVOIRS.

Cylinder.	Supplementary.	Capacity.	(Or Two.)	Capacity. Each.
8 inch	14 x 33	4,476	10 x 33	2,125
10 inch	16 x 33	5,724	12 x 33	3,088
12 inch	16 x 48	8,577	14 x 33	4,476
14 inch	20½ x 36	10,158	16 x 33	5,724
16 inch	20½ x 48	14,003	16 x 42	7,436
18 inch	22½ x 54	18,967	20½ x 36	10,158

P.C. EQUIPMENT.

Cylinder.	Service Res.	Capacity.	Emergency Res.	Capacity.
2—10	14 x 33	4,476	12 x 33	3,117
2—12	16 x 33	5,724	14 x 33	4,476
2—14	16 x 48	8,577	16 x 42	7,436
2—16	20½ x 36	10,158	16 x 48	8,577
2—18	20½ x 48	14,003	20½ x 36	10,158

CAPACITY OF OTHER RESERVOIRS.

10 x 14½	890	10 x 20	1,221	10 x 24	1,588
10 x 28	1,809	10 x 33	2,125	12 x 27	2,450

With the P.C. equipment, service and emergency reservoirs and brake cylinders are so proportioned that an equalization of pressure of 86 lbs. will be obtained from 110 lbs. brake pipe or reservoir pressure with 8 inches piston travel.

FREIGHT CARS.

Equipment.	Weight.	Cylinder.	Triple Valve.
Detached	to 21,000	6 x 8	H 1 or K 1
"	22,000 to 37,000	8 x 12	H 1 or K 1
"	37,000 to 58,000	10 x 12	H 2 or K 2
Combined	to 21,000	6 x 8	H 1 or K 1
"	22,000 to 30,000	8 x 8	H 1 or K 1
"	22,000 to 37,000	8 x 12	H 1 or K 1
"	37,000 to 58,000	10 x 12	H 2 or K 2

Mikado Type of Locomotive for the Northern Pacific Railway

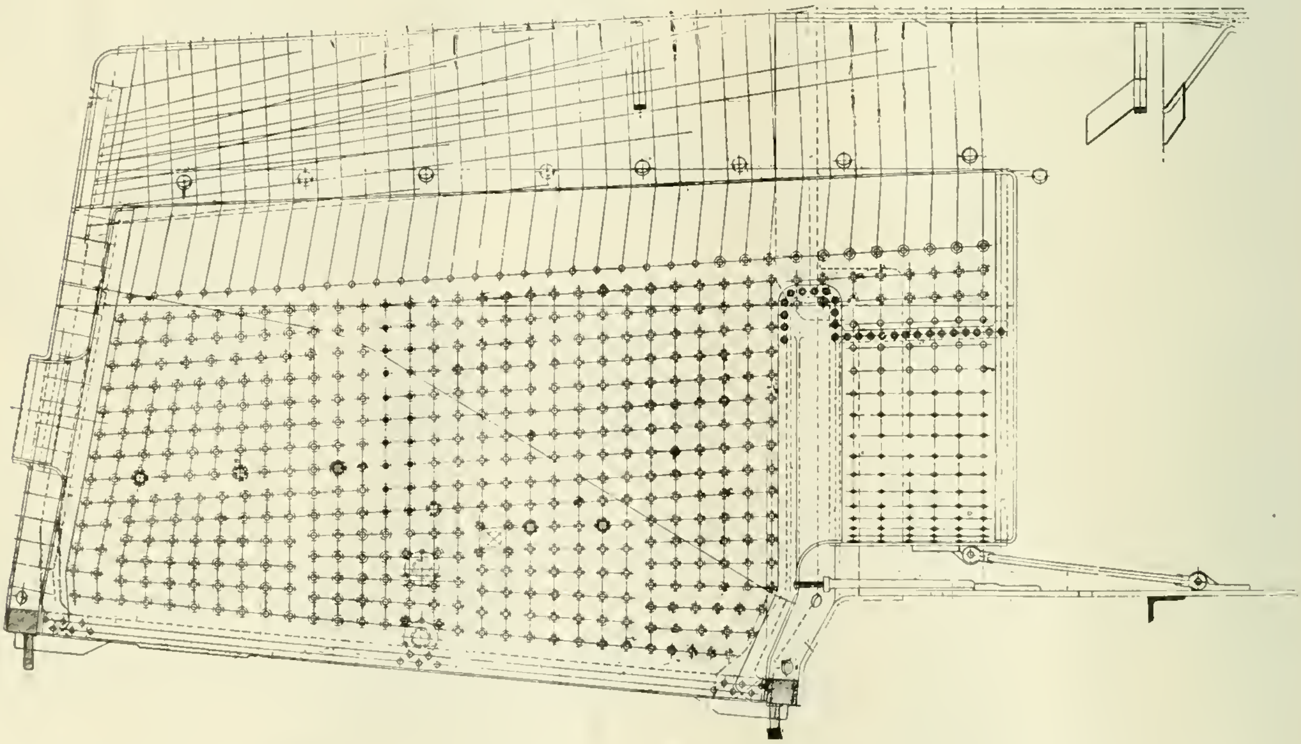
The American Locomotive Company has recently delivered fifty Mikado type locomotives to the Northern Pacific railway. They have been placed in service in the Yellowstone, Montana and Rocky Mountain divisions. The Yellowstone division is 441 miles long and has a maximum grade of one per cent. against both east and westbound traffic. The new Mikados are at present hauling 1,800 tons over this district at an average speed of from eight to ten miles per hour.

In comparison with an older type of Mikado these new locomotives have increased the train loads on a portion of the divisions nearly 30 per cent., and the latest reports indicate a considerable saving in coal and water per thousand ton miles.

On the Rocky Mountain division, from Helena, Mont. to Paradise, Mont., a distance of 219 miles, there is a maximum grade from Helena to Blossburg, seventeen miles in length of 2.2 per cent. Over a portion of this grade a Mallet helper is used. The new Mikados are hauling 2,600 tons from Missoula to Garrison at an average speed of sixteen miles per hour. The older type known as W Mikado hauls 2,200 tons at an average speed of twelve miles per hour. On this division the new Mikados are making 41,600 ton mile hours as against 26,400 for the W Mikados, with no appreciable increase in oval consumption.

It is interesting to note the extensive use of Mikado engines on the Northern Pacific Railway. This road is now using more Mikado locomotives than any other road in the United States. The class W Mikado was first built by the American Locomotive Company in 1904, and up to the present time 270 Mikado locomotives have been built for this road by the same builders. The new class recently delivered, and which are known as W 3 Mikados, are a development of the original design. These new Mikados are the

MIKADO 2-8-2 TYPE LOCOMOTIVE FOR THE NORTHERN PACIFIC RAILWAY.
H. M. Curry, Mechanical Superintendent. American Locomotive Company, Builders.



FIREBOX OF MIKADO TYPE LOCOMOTIVE SHOWING DETAILS OF COMBUSTION CHAMBER.

product of the long experience of the American Locomotive Company in the development of powerful locomotives. The application of this experience to the railroad's specific requirements was directed by the officials of the motive power department, to whose valuable co-operation in the preparation of the design the success of these locomotives is largely due.

The Mikado design combines a Schmidt superheater, firebrick arch, smoke consumer tubes in the sides of firebox and a 36-in. combustion chamber. Included in the design are the builder's latest design of valve stem guide, piston rod extension guide, outside steam pipes, power reverse gear, and the builder's latest design of outside bearing trailing truck.

The following are the general dimensions of the new Mikados:

Tractive power—57,200 lbs.

Cylinders—28 ins. x 30 ins.

Working pressure—180 lbs.

Boiler—Type, ex. wag. top; diameter, front end, 83⅝ ins.; back end, 96 ins.

Firebox—Length, 120⅛ ins.; width, 84¼ ins.; grate area, 70.4 sq. ft.

Tubes—Number and diameter, 212; 2¼ ins.

Flues—Number and diameter, 40; 5½ ins.

Tube—Length, 18 ft.

Combustion chamber—Length, 36 ins.

Heating surface—Tubes, 3,266 sq. ft.; firebox, 290 sq. ft.; arch tubes, 35 sq. ft.; total, 3,591 sq. ft.

Superheating surface—846 sq. ft.

Driving wheels—Diameter, 63 ins.

Driving journal—Main, 11½ ins. x 14 ins.; others, 10½ ins. x 14 ins.

Trailing wheel—Diameter, 42 ins.; journal, 9 ins. x 14 ins.

Truck wheel—Diameter, 33½ ins.; truck journal, 6½ ins. x 12 ins.

Wheel base—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total of engine, 35 ft. 3 ins.; total of engine and tender, 68 ft. 2¼ ins.

Weight on driving wheels, 240,500 lbs.; front truck, 30,500 lbs.; trailing truck, 49,000 lbs.; of engine total, 320,000 lbs.; of tender, 193,900 lbs.

Capacity of tender—Water, 10,000 gals.; fuel, 16 tons.

Fuel—Bituminous coal.

The Railway As a Public Servant.

Nearly all the people who have worked under Mr. Julius Kruttschnitt admit that he is one of the most agreeable and just officials they have ever known. This being acknowledged the views of Mr. Kruttschnitt on the public attitude towards railways as contributed to *Leslie's Weekly* will be read with interest.

Mr. Kruttschnitt writes:

"It is evident," he says, "that if the public is to get satisfactory results from its servant, the railway, it must take care that it be so treated that it will be kept in vigorous health. The railway cannot maintain vigorous health if it is not allowed sufficient earnings to sustain it in good physical and financial condition, or if burdens are imposed on it which are too heavy for it to bear.

"The immediate determination of what earnings it shall be permitted to receive and what burdens it shall have put on it is in the hands of the other servants of the public mentioned, chiefly the commissions and Legislatures. If the railway is guilty of acts of omission or commission which are inconsistent with its public duty, these other servants of the public should adequately restrain and punish it. But when the railway is doing its best to perform its duty it is obviously contrary to the interest of the public for it to be subjected to unnecessary restraints and penalties."

Mr. Kruttschnitt discusses the wage increases in the last few years, largely enforced by arbitration under the Erdman act; legislative requirement of more men to a train, changes in equipment required by law, involving the abandonment of others in use; laws limiting the hours of service and requirements "in the nominal or real interest of safety." Of the "full crew" legislation he says:

"The Legislatures have, in effect, robbed the railways and given the spoil to unnecessary employees in order that the members of the Legislatures might get the votes of railway labor. In allowing one servant to be thus robbed of the fruits of his thrift by a fellow-servant, has not the master been clearly at fault? Has he not disregarded not only the rights of the servant who has been robbed, but his own interest?"

Of laws requiring different headlights in place of those in use he says:

"The railways using these efficient and expensive devices were forced to discard them and incur heavy additional outlay for specialties promoted by inventors and private corporations whose claims were strongly advocated by lobbies of promoters and labor representatives whose disinterestedness had not always been above suspicion."

The railway, Mr. Kruttschnitt concludes, "cannot render the service its master expects and demands without sufficient means. There is not a railway manager in the country today who is not fearful that under the press of increasing demands the transportation system of the country will in a few years break down unless the railways are allowed to earn larger funds wherewith to build it up. They must have more double tracks, terminals and yards; new and larger stations; they must eliminate grade crossings and make other improvements, to handle the increasing density of traffic resulting from the growth of population and wealth.

"There are vast sections of the country, especially in the West, where more railroads are needed, and they cannot be built unless the railways can raise new capital. Now, there never was such a world-wide demand for capital as there is at this time. And what are the facts as to the ability of the railways of the United States to get capital? There never was a time when railroad investments were more unattractive. The interest rates that the railways must pay are very high and they are steadily increasing.

"It was justifiable and necessary that the public should assert itself to stop the abuses. But it is not necessary in order to stop misconduct on the part of railway managements to destroy the efficiency of the railways and sap their financial strength. The public should understand that in exercising the power it cannot shirk the responsibility of the master. The welfare and health and strength of the servant must be conserved if he is to render the service which the master expects and needs."

Hints on Hardening Steel.

In regard to hardening tools it should be borne in mind that warm water is safer to use than cold. On steel of unknown grades it is safest to try this way, the first time at least, for the danger of cracking is less. Any good steel will harden in warm water except in rare cases. Some prefer boiling water. The same instructions apply to the use of oil. Oil-tempered is a synonym for well-tempered or tough-tempered. If fish oil is not available, any oil will do as well to a certain extent. Oil poured on the surface of the water in the barrel is good. The tool must first pass through the oil before reaching the water bath and it is hardened slowly. As a general rule the temperature of the work must be greater when it is to be quenched in oil than in water.

If a quantity of small parts is to be heated, a pot of hot lead is the best way to obtain uniform temperature. Any cast-iron pot will do for a small quantity—even a ladle—but the most lasting pot is the one with a thick bottom. A thin cast-iron shell soon burns through. For drawing the temper on a quantity of articles use a cast-iron pot with heavy steam-cylinder oil. A thermometer reading to 600 or 700 degs. F. is necessary for this bath. These pots can be placed on the blacksmith's fire and the coals built up around the sides to hold the heat within.

A scale, showing the temperature at which different classes of tools should be temper-drawn, also their color at that temperature, is of much value for temper-drawing with oil or by color.

Electrical Department

Electro-Metallurgy.

Every one is familiar with the uses of electricity for lighting, for power, for railways, etc., but very few are acquainted with or realize what an important part electricity plays in production of the various metals used so extensively today. The various processes themselves are extremely complex, but the results obtained along these lines are very interesting.

Electricity can be and is used to break down, to build up, to cover over, to uncover, to separate and to blend. Each process is a distinct industry.

The first process is best illustrated by the manufacture of aluminum. Aluminum, in its natural state, is in clay known as banxite, combined with oxygen. There are several processes for breaking down the aluminum, one of which is known as Hall's process, and which is operated on a large scale at Niagara Falls, where electricity can be obtained in large quantities. An iron vessel lined with carbon is used. The electric current causes pure aluminum to settle to the bottom when it is tapped off. Temperatures from 1,600 degrees to 1,800 degrees Fahr. are required, and are obtained by the passing of 5,000 amperes of electric current through the material.

In the "building-up" process the metal is formed directly on one of the terminals through which the electric current is passing. Pure calcium is formed in this manner. The terminal on which the calcium metal is deposited is suspended over and just touches the molten mass.

The third process mentioned, "to cover," is that of electroplating, which is the art of coating articles with an adherent layer of metal. The article to be plated is placed in a liquid solution of the metal to be deposited. An electric current is then passed through the liquid, the article to be plated serving as one of the terminals. The electric current removes the metal from the solution and deposits it evenly on the article. The amount of the metal deposited depends on the time the electric current is flowing and the rate of deposit depends on the value of the current. The rate of deposit per unit of electric current or per ampere is known for each and every metal, so that the thickness of metal desired can be exactly obtained.

"Uncovering" is a process just the reverse of electroplating, and is of great value and importance in the recovery of tin from waste occurring in the manufacture of tin cans, boxes, etc.

The most important application of electricity in this field of electrometallurgy is the refining of copper. Over half of the world's production of copper is refined by this process, which is a vast amount, for nearly a million tons a year are required. The crude copper obtained from the smelting furnaces is cast or rolled in the form of plates. One of these plates, together with a thin sheet of pure copper, is placed in a solution of copper sulphate (blue vitriol) and an electric current is passed between the plates. The pure copper dissolves from the crude copper plate, is carried through the solution and is deposited in the form of pure copper on the pure copper plate. The impurities are left behind as a scum or sediment. The amount of pure copper separated in this manner can be easily determined, and as in electroplating, depends on the amount of the current and the time it is flowing. In practice it requires 400 to 475 amperes flowing for one hour to deposit one pound of copper.

Materials are "blended" by the use of electricity, when two or more different materials make a product differing from either or all. For instance, carborundum, a substance of extreme hardness, is made by the breaking up and rebuilding of a clay. Carborundum is made by the blending of coke, sand and sawdust.

The processes of electro-metallurgy have reached such perfection that the entire product of some materials and a large percentage of others are obtained by these means. Among these are copper, aluminum, gold, silver, calcium carbide (used for the manufacture of acetylene gas), calcium, graphite, chrome and vanadium steels, silicon, sodium and nickel.

Norfolk & Western Railroad to Electrify.

The Norfolk & Western Railroad, which extends from the Tidewater at Norfolk, Va., to the coal fields of West Virginia, has contracted with the Westinghouse Electric & Manufacturing Company to supply all the electrical apparatus required to electrify the Bluefield-Vivian section of its line, some 85 miles in length.

The carrying out of this contract will give form to one of the most important projects of steam railroad electrification yet undertaken. The contract calls for the manufacture and delivery of twenty-six 130-ton electric locomotives of the single-phase two-phase type, together with all required power house generating machinery and transmission apparatus.

Single-phase alternating current of a frequency of 25 cycles and at 11,000 volts pressure will be supplied to the locomotives through an overhead trolley wire and will be the identical type of the overhead system that has long been successfully used by the New York, New Haven & Hartford Railroad on its main line, by the Boston & Maine in the Hoosac Tunnel, by the Grand Trunk Railway in the Sarnia Tunnel and by the New York, Westchester & Boston Railway and for which installations the Westinghouse Electric Company has furnished over 100 locomotives. The Norfolk & Western single-phase two-phase locomotives, besides being very large and of enormous hauling capacity, will embody many unique features and requirements of design which, it is expected, will result in their showing unprecedented flexibility and economy of operation.

The Bluefield-Vivian section serves the celebrated Pocahontas coal region, one of the largest coal fields in the world. The tonnage of coal handled amounts to 65,000 tons per day, necessitating trains weighing as high as 3,250 tons. It is to facilitate the handling of this heavy traffic that the electrical operation has been decided upon.

There are a number of grades on this section, the maximum being two per cent., and at the present three Mallet locomotives (the most powerful type of steam locomotives built) are required per train. One locomotive is used at the head of the train and two for pushing.

Only two electric locomotives will be required for this service and the present speed will be doubled. The extent to which this quick train movement will enlarge the capacity of the railroad is quite apparent.

One of the present impediments to rapid operation of this section of the road is the extension of a 3,100-foot tunnel which is difficult to ventilate. This tunnel under electric operation will, of course, owing to the absence of smoke and noxious gases offer no impediment to frequent train movement.

Since the Norfolk & Western locomotives are intended for handling what is

known among railway men as "tonnage trains" they will be built for running speeds of approximately seven, fourteen and twenty-six miles per hour.

The design of the electric equipment will be such that the tonnage can be readily increased in the future as the service demands.

Power for the entire electrified section will be generated in a central power house located at Bluestone, W. Va., with an installed capacity of 27,000 kilowatts in turbo generators, supplied by the Westinghouse Company.

The traffic conditions of this section of the road are especially well adapted to electrical operation. It is in reality a separate engine division at present, and can be operated electrically without affecting the cost of engine service on other sections of the line.

Conditions that are conducive to high economy in an electrification like that of the Norfolk & Western are:

1. Traffic requirements such that a minimum electrical equipment will give practically continuous service.
2. Fewer engine crews per train.
3. The speed of operation over the division will be nearly double that possible with present steam equipment.
4. Increased capacity of electrified section.
5. Electric locomotives are not limited to the short hours of service on account of boiler and fire conditions as in steam locomotives.
6. Watering and coaling delays incident to steam operation will be entirely eliminated.
7. The general reliability of locomotive operation will be considerably improved.

Work will be begun at once, and the contract calls for its completion in the summer of 1914.

Electric Arc Welding.

Although welding has been done with electricity for many years, still it is only recently that its real value has been appreciated and that this method has been used for many kinds of work where welding is required.

The electric arc is the hottest flame known and this fact is used in this method of welding. One terminal of the source of electric power is fastened to the casting. The other lead is fastened to a stick of carbon or to a metal rod according to the nature of the job. The carbon is touched to the casting and when drawn away an electric arc is formed. The temperature of this arc is between 3,500 and 4,000 degrees centigrade. The casting under this extreme heat at the point of contact softens and the metal can be welded, melted away, moulded into a different shape or fused to another piece of metal. The carbon terminal is used where heavy work is required; for light repair work a metal terminal is used, usually of soft Swedish iron. This metal terminal melts with the arc supplying the necessary metal to make the repairs. This latter process is used to a great extent in railway shops, for flue welding and boiler and fire box repairs, as well as numerous other jobs.

Electric Publications.

The Westinghouse Electric & Mfg. Company has just issued leaflets Nos. 3572 and 3660, covering the electrification of the Pennsylvania New York Extension of the Pennsylvania Railroad, and the New York, New Haven & Hartford Railroad respectively.

These leaflets cover the salient points of both roads together with a description of the more important parts of the equipment. These leaflets are well illustrated and contain maps showing the territory covered by both the electrified systems.

Electric Fans.

The electric fan is almost universally used at the present day. One of the latest applications is for use in railroad trains. The prevailing custom of car builders now is to use electric lights in their cars so that it is a simple matter to connect the electric fans to the storage battery. Railroad companies can thus furnish comfort to their patrons in the most difficult season of the year.

A New Porcelain Strain Insulator.

A porcelain strain insulator of high strength, both mechanically and electrically, has been placed on the market by the Westinghouse Elec. & Mfg. Co., and is intended for use on 1,500-volt direct-current railway work and on 2,200-volt transmission lines.

It is claimed that the insulators will stand more strain than any cable used in line construction that will pass through the hole. They are of the interlocking type which makes it impossible for the cables to separate even if the insulator should become shattered.

The illustration shows one of these insulators in place in a guy or pull off. Sharp corners which would be apt to chip have been avoided, and large creepage surfaces have been provided. The smaller size has a flash-over voltage on rain test of over 13,000 volts six times normal voltage, and the larger size over 20,000 volts. The tensile strength is extremely high, that of the larger size insulator being over 23,000 lbs. and its dimensions are only 5 x 4½ x 4½ inches.

NEW PORCELAIN STRAIN INSULATOR.

Automatic Voltage Regulators.

It is very important in many kinds of service where electric current is used to have the voltage of supply keep constant at a certain value without a variation above or below this value. This applies to lighting systems and is of advantage in that more economical lamps can be used. The lamps can be operated at a higher efficiency if the voltage is constant, as a lamp can be used which has its highest efficiency at this voltage and which could not be used if there was a great variation in voltage. Besides, few lamps are renewed. A sudden rise in voltage will cause the weakest lamps to burn out which, with constant voltage, would last for several weeks longer. Lamp renewals mean increase in cost. Electrical energy or power is saved, as the generators only deliver the exact amount of power required. A slight increase of voltage on a large system means increase of losses in transmission of the electrical energy to the lamps. The regulators serve as well to keep up the voltage to its proper value and by this means prevents a decrease in the energy required, which of course means a falling off in revenue. This decrease in energy or electric power is very marked with the falling off of the voltage. With the installation of the automatic regulators the number of switchboard attendants can be reduced with a corresponding saving.

College Professors in Shops.

During the past summer there have been twenty-eight college professors, representing twenty-six colleges, from all parts of the United States, spending their vacations at the works of the Westinghouse Electric & Mfg. Co., working side by side with skilled mechanics.

This co-operation between industrial and educational institutions is of great value. College professors are usually lacking in practical knowledge of works management and efficiency methods, and it is hoped by this work at the factory that such knowledge will be gained. The Westinghouse company is a warm supporter of this movement and delegated its officials and engineers to meet and explain to these men from the various colleges the work of the various departments.

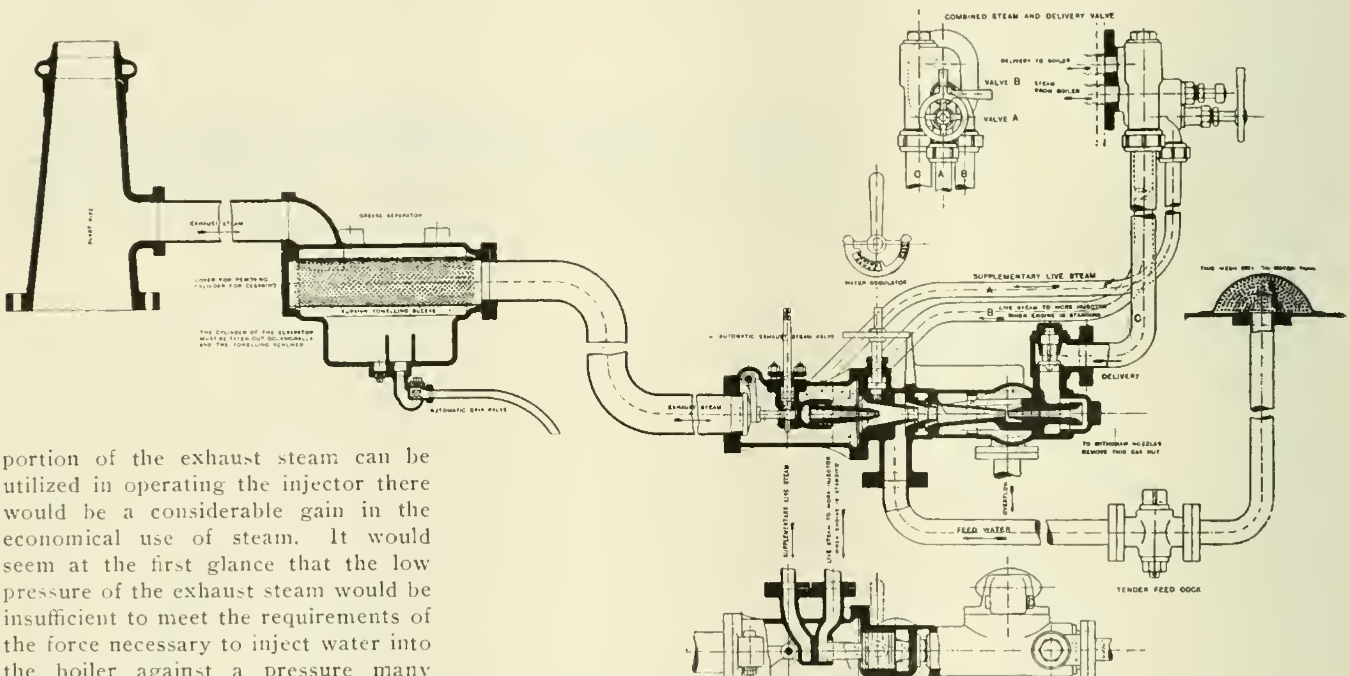
Metcalfe's Locomotive Exhaust Steam Injector

A recent improvement in injectors as applied to the locomotive is being introduced into American locomotive practice, and as the improvement has already been fully tested and approved of by leading European engineers, its merits may be stated as assuredly of real value.

There are two things that are universally admitted in locomotive practice, first that it takes a great deal of steam to operate the common injector, some authorities claiming that as much as ten per cent. of the entire steam produced by the boiler is used in operating the injectors, and secondly, that there is considerable loss by the exhaust steam from locomotives.

It must also be admitted that if a portion of the exhaust steam can be utilized in operating the injector there would be a considerable gain in the economical use of steam. It would seem at the first glance that the low pressure of the exhaust steam would be insufficient to meet the requirements of the force necessary to inject water into the boiler against a pressure many times higher than the exhaust steam could possibly be, but this assumption is based on an erroneous idea of the actuating principle which operates the injector. This seeming impossibility, however, is easily explained when the action of the exhaust steam on the water is considered.

An injector may be defined as an apparatus in which a jet of steam moving at a high velocity is condensed by a body of water moving at a low velocity, the momentum of the steam jet moving with a resultant velocity sufficient to overcome the boiler pressure. As is well known, exhaust steam at atmospheric pressure has no velocity, but will move, cloud-like, and condense slowly into drops of water, but if such steam be allowed to issue into a vacuum, it has a velocity of over 2,000 feet per second. Hence the rapid condensation of the exhaust steam by coming in contact with the feed water in the combining nozzle of the injector creates a vacuum, the highest point of the vacuum being at the point of the steam nozzle, where the steam and water meet. Into this vacuum the exhaust steam flows at an exceedingly high velocity. The steam is condensed and gives up its momentum to the combined jet, which then flows along the combining nozzle, where complete condensation takes place, and the combined jet flows at a velocity sufficiently high to carry it forward through the delivery nozzle into the boiler.



LOCOMOTIVE EXHAUST STEAM INJECTOR.

A series of carefully conducted tests on the Great Western Railway of England under ordinary conditions has shown an actual economy of eight or nine pounds of coal and about forty pounds of water per mile. It was also noted that the application of the exhaust steam injector reduced the back pressure considerably, thus increasing the power of the engine.

The device clearly demonstrates the fact that the working of an injector is not dependent on the steam being supplied under high pressure as is so often supposed, the sole determining factor being the steam velocity. It may be noted, however, that the exhaust steam has also its limitations. Tests have shown that at a pressure of 1 pound per square inch, a delivery pressure of 120 pounds is obtained, at 10 pounds pressure of exhaust, 180 pounds delivery is obtained, and at 15 pounds exhaust, there is a delivery pressure of 210 pounds for each square inch of area.

In order to meet the exigencies of high pressure service, there is a live steam nozzle of small bore at the entrance to the main exhaust nozzle. As shown in the accompanying illustration, it obtains its steam supply through the passage shown in the exhaust valve casing from a pipe connected to the supplementary steam valve on the boiler. The small jet of steam introduced through this nozzle gives the additional force required to feed the boiler under extra high pressures. Adjustable valves regulate the exhaust supply and also the high pressure supply, and it may be readily understood that it is sometimes necessary to work the injector as a live steam injector, as when the engine is standing, and when thus working, the pressure of the live steam automatically closes the exhaust steam valve, so that the perfect vacuum necessary may be maintained. It will thus be seen that to change from exhaust steam to live steam working, it is only necessary to open the steam supply to the auxiliary steam pipe, when the injector will work as efficiently as before.

As shown in the illustration, the exhaust steam on its way from the exhaust pipe to the injector passes through what is known as a Grease Separator, which is fixed in any position, preferably at the lowest point. This removes all particles of grease or other matter which may have been carried along the blast pipe.

Hydraulic Car Coupler Shear and Riveter

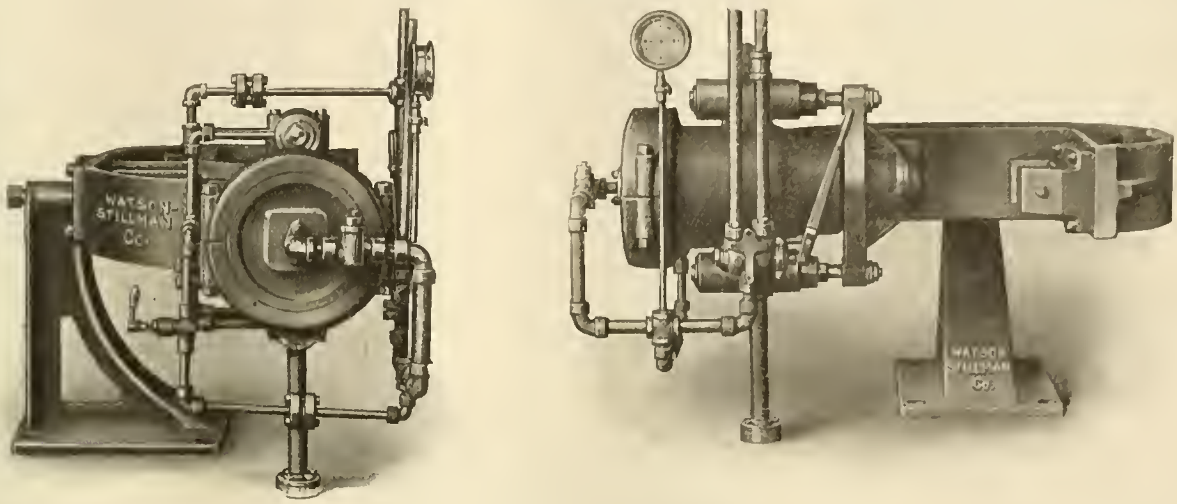
The Watson-Stillman Company, 50 Church street, New York, has just added another important type of hydraulic press to its line—an open jaw tool for shearing and riveting car couplers. It may also be used for miscellaneous shop jobs. Two views of the tool are shown here.

The cylinder is an integral part of the body of the machine, which is a steel casting made like an open jaw riveter frame. It is pivoted to the stand from the back face, instead of being bolted to it from the bottom. This permits the casting to be swung from the position shown to the vertical or vice versa by merely loosening the clamping bolt and making a slight re-arrangement of piping.

The end of the main ram works into a hole in a yoke with wings projecting beyond the sides of the main cylinder, where they join piston rods that work into small cylinders paralleling the main cylinder and bolted to it on diametrically opposite sides. The liquid, water or oil, is admitted to all the cylinders simultaneously, but because the displacement of the side cylinders is considerably less than that of the main cylinder, the yoke travels faster, reaches the work ahead of the main ram and clamps the coupler yoke to the car coupler, forces the rivet into place, making everything ready for upsetting the rivet by the time the main ram catches up. If the yokes are being sheared from the couplers, the action of the clamping yoke is unnecessary, so a stop valve is provided for cutting it out of service during this operation. The yoke and the main ram therefore travel out together. One stroke of the rams will upset one or shear two rivets. The clamping cylinders are made double-acting in order that the return stroke can be effected by them.

When the machine is in the position shown there is no superstructure above the gap, thus permitting couplers to be carried to it by an overhead trolley, suspending them exactly in positions for either shearing or riveting. If in a vertical position the coupler may be swung into the dies in the same manner and with the same ease with which a billet is moved from a fire or furnace to an open jaw steam hammer.

With the use of this tool the handling of parts for riveting and shearing couplers is reduced to a minimum, which, combined with the simplicity and rapidity of the tool itself, reduces the cost of this work far below anything ever known before this tool was produced. Its merits have been already fully demonstrated in many leading railroad shops.



HYDRAULIC CAR COUPLER SHEAR AND RIVETER.

Tests on Locomotive Fireboxes.

As the result of a series of tests, it has been shown that, 1, the outwardly inclined water leg is the most desirable as far as the water circulation is concerned; 2. the direction of rolling of the sheet affects its ability to withstand the strains imposed in service, and that the direction of rolling should be specified; 3, the relative values of the different steels to withstand these strains are in the order of nickel, acid and basic; 4, the lowest specification carbon content and tensile strength requirement should be asked for and accepted; and, 5, the single piece firebox as now applied is a mistake.

Reports indicate that the use of lignite as a locomotive fuel is increasing in the northwestern portion of the United States. This is due to the high cost of good coal, and the proximity to large areas of lignite. The latter gives very good results when briquetted, as the heating value is increased, and the rapid deterioration incidental to raw lignite when stored, is largely decreased. The heat value of briquetted lignite is about 9,000 B. T. U.

Changing Signals

Recently the New York, Ontario & Western has adopted green for the night clear indication in fixed signals and yellow for caution, and has changed the colors of signal blades also following in general the standards in force on the New York, New Haven & Hartford. Heretofore, automatic signals had blades with square ends and train order signals had pointed blades. The accepted standard has now been made universal throughout the length of the company's lines; automatic block signal arms, pointed; distant signal arms, fish-tail, and painted yellow; train order signals with rounded ends. The color of switch targets and lights was also changed at the same time.

He Must Wait and Work.

Perhaps the greatest lesson which the lives of literary men teach us is told in the single word, "Wait." Every man must patiently bide his time; he must wait. . . . The voices of the Present say "Come!" but the voices of the Past say "Wait!" With calm and solemn footsteps the rising tide beats against the rushing torrent upstream and pushes back the hurrying waters. With no less calm and solemn footsteps, nor less certainly does a great mind bear up against public opinion and push back its hurrying stream. Therefore should every man wait; not in listless idleness, not in useless pastime, nor in querulous dejection, but in constant, steady, cheerful, endeavor always willing and fulfilling and accomplishing his task that when the occasion comes he may be equal to the occasion. And if it never comes what matters it to the world whether I or you or another man did such a deed or wrote a book so be it that the deed or book were well done.

Let us be silent that we may hear the whispers of the Gods.

—*Emerson.*

Items of Personal Interest

Mr. H. E. Myers has been appointed shop superintendent of the Lehigh Valley at Packerton, Pa.

Mr. F. E. Wees has been appointed general foreman on the Ann Arbor with office at Frankfort, Mich.

Mr. C. P. Klueppelberg has been appointed master mechanic of the Gulf Line with office at Ashburn, Ga.

Mr. C. L. Bunch has been appointed general foreman of the Southern, with office at Spencer, N. C.

Mr. J. E. Breyer has been appointed master mechanic of the Southern, with office at Charleston, S. C.

Mr. L. E. Wingfield has been appointed master mechanic of the Arkansas Central, with office at Pan's, Iowa.

Mr. W. Roberts has been appointed locomotive foreman of the Chicago Great Western at Hayfield, Minn.

Mr. J. B. Quackenbush has been appointed road foreman of engines of the Erie at Jersey City, N. J.

Mr. William B. Skipworth has been appointed general foreman of the Southern, with office at Columbus, Ga.

Mr. M. H. Farrell has been appointed shop foreman of the Western Allegheny, with headquarters at Kayler, Pa.

Mr. John Sutherland has been appointed master mechanic of the Iowa & Illinois, with office at Clinton, Iowa.

Mr. Herbert Reid has been appointed locomotive foreman of the Canadian Pacific, with office at St. Ignace, Mich.

Mr. William H. Sloat has been appointed master mechanic of the Dayton & Union, with office at Dayton, Ohio.

Mr. C. J. Drury has been appointed general foreman of the St. Louis & San Francisco, with office at Springfield, Mo.

Mr. F. O. Peoples has been appointed master mechanic of the Ohio River & Western, with office at Zanesville, Ohio.

Mr. J. E. McLean has been appointed master mechanic of the Kansas City Southern, with office at Pittsburg, Kans.

Mr. J. H. Green has been appointed master mechanic of the Halifax & Southwestern, with office at Bridgewater, N. S.

Mr. H. J. Heilig has been appointed road foreman of engines on the Southern, with headquarters at Greensboro, N. C.

Mr. C. E. Magee has been appointed master mechanic of the Gulf & Sabine River Railway, with office at Fullerton, La.

Mr. R. A. Bellingham has been appointed master mechanic of the Apalachicola Northern, with office at Ft. St. Joe, Fla.

Mr. R. A. Becket has been appointed superintendent of signals of the Grand Trunk, with headquarters at Montreal, Que.

Mr. Joseph Pollock has been appointed master mechanic of the Jefferson & Northwestern, with office at Jefferson, Tex.

Mr. P. Ryan has been appointed roundhouse foreman of the Intercolonial Railway of Canada at Chaudiere Junction, Que.

Mr. Joseph Cole has been appointed superintendent of motive power of the Vera Cruz Railway, with office at Alvarado, Mex.

Mr. M. H. Oakes has been appointed assistant master mechanic on the Baltimore & Ohio with office at Cumberland, Md.

Mr. William Baumterger has been appointed road foreman of engines on the Lake Erie & Western, with office at Lima, Ohio.

Mr. J. W. Highleyman has been appointed assistant master mechanic of the Union Pacific, with office at Cheyenne, Wyo.

Mr. W. P. McDevitt has been appointed general foreman of the Southern, with office at Macon, Ga., succeeding Mr. J. E. Breyer.

Mr. S. R. Mathes has been appointed general foreman of the Atlanta, Birmingham & Atlantic, with office at Manchester, Ga.

Mr. E. Fuller, formerly master mechanic of the Southern at Charleston, S. C., has been transferred to Alexandria, Va.

Mr. G. W. Lillie has been appointed mechanical superintendent of the Chicago, Rock Island & Pacific with office at Topeka, Kans.

Mr. H. J. Osborne has been appointed superintendent of motive power of the South Dakota Central, with office at Sioux Fall, S. D.

Mr. N. M. O'Laughlin has been appointed supervisor of signals on the Northern Pacific, with headquarters at St. Paul, Minn.

Mr. W. L. Thomas has been appointed master mechanic of the Cananea Consolidated Copper Company's railway at Sonora, Mex.

Mr. F. Rilner has been appointed master mechanic of the Cincinnati, Georgetown & Portsmouth with office at Cincinnati, Ohio.

Mr. George Duncan has been appointed mechanical superintendent of the Atlantic, Quebec & Western with office at New Carlisle, Que.

Mr. J. N. Weaver has been appointed road foreman of engines on the Baltimore & Ohio, with headquarters at New Castle Junction, Pa.

Mr. J. J. Romkine has been appointed locomotive foreman of the Inverness Railway & Coal Company, with office at Inverness, N. S.

Mr. A. C. Breisch has been appointed master mechanic of the Chicago, Rock Island & Pacific, with headquarters at Armourdale, Kans.

Mr. G. H. Dryden has been appointed principal assistant signal engineer of the Baltimore & Ohio, with headquarters at Baltimore, Ohio.

Mr. W. A. Rizor has been appointed foreman of water service on the Chicago, Burlington & Quincy, with headquarters at Greybull, Wyo.

Mr. F. S. Robbins has been appointed assistant master mechanic of the Pittsburgh division of the Pennsylvania, with office at Pittsburgh, Pa.

Mr. Charles L. McIlvaine has been appointed master mechanic of the New York, Philadelphia & Norfolk with office at Cape Charles City, Va.

Mr. J. A. Read has been appointed general foreman of the locomotive department of the Georgia Southern & Florida, with office at Macon, Ga.

Mr. F. G. Kumkel has been appointed machine shop foreman of the Minneapolis & St. Louis at Marshalltown, Iowa, succeeding Mr. W. A. Yanda.

Mr. G. A. Gibson has been appointed roundhouse foreman of the Central Vermont at White River Junction, Vt., succeeding Mr. W. G. Cross.

Mr. John H. Tinker has been appointed superintendent of motive power and machinery of the Chicago & Eastern Illinois, with office at Danville, Ill.

Mr. P. J. Clark has been appointed superintendent of motive power of the Georgia, Florida & Alabama, with headquarters at Bainbridge, Ga.

Mr. W. C. Greening has been appointed master mechanic of the Pere Marquette with office at Wyoming, Mich., succeeding Mr. J. E. Hickay, resigned.

Mr. J. Miller has been appointed general foreman of the locomotive department of the Burnside Shops of the Illinois Central at Chicago, Ill.

Mr. F. A. Hussey has been appointed road foreman of engines of the Boston division of the Boston & Albany, with headquarters at Beacon Park, Mass.

Mr. J. M. Solis has been appointed assistant superintendent of locomotive service of the National Railways of Mexico with office at Cardenas, S. L. Mexico.

Mr. W. N. Mitchell has been placed in charge of the education of the firemen in the use of fuel on locomotives on the Chicago Great Western, with headquarters at Chicago.

Mr. M. P. Healy has been appointed road foreman of engines of the Erie at Buffalo, N. Y., and Mr. P. D. Gregg has been appointed to a similar position on the same road at Meadville, Pa.

Mr. Hugh Montgomery has been appointed superintendent of motive power and rolling stock of the Rutland Railroad with headquarters at Rutland, Vt. He succeeds Mr. F. C. Cleaver, resigned.

Mr. C. D. Porter, formerly assistant master mechanic of the Pennsylvania, has been appointed assistant to the general superintendent of motive power on the same road, with office at Altoona, Pa.

Mr. A. B. Adams, formerly general foreman of the Gulf, Colorado & Santa Fe at Cleburne, Tex., has been appointed master mechanic of the Beaumont division of the same road with office at Silsbee, Texas.

Mr. J. C. Tipton has been appointed Canadian representative of the Galena-Signal Oil Company, with headquarters at 603 Shaugnessy Building, Montreal. Mr. Tipton succeeds the late Mr. A. Lichtenhein.

Mr. H. C. Van Buskirk has been appointed mechanical superintendent of the first district of the Chicago, Rock Island & Pacific with headquarters at Des Moines, Iowa, succeeding Mr. J. B. Kilpatrick, resigned.

Mr. W. F. Merry has been appointed master mechanic of the Southern Pacific, with office at Los Angeles, Cal., and Mr. G. H. Goodwin has been appointed general foreman of the locomotive shops on the same road, also at Los Angeles.

Mr. G. A. Schmoll, formerly district superintendent of the Baltimore & Ohio at Wheeling, W. Va., has been appointed superintendent of motive power on the same road with office at Pittsburgh, Pa., succeeding Mr. E. J. Searles, resigned.

Mr. J. E. McQuillen, formerly division master mechanic of the Gulf, Colorado & Santa Fe at Silsbee, Tex., has been appointed mechanical superintendent on the same road with office at Cleburne, Tex., succeeding Mr. P. T. Dunlap, resigned.

Mr. M. F. Ryan, who has been connected with the Pittsburgh Spring & Steel Company for the past ten years, has been appointed General Western Sales Agent of that company with offices at 1411 and 13 Fisher Building, Chicago, Ill., in place of Mr. L. C. Noble, deceased.

Mr. D. T. Main, formerly master mechanic of the Canadian Pacific at Moose Jaw, Sask., has been transferred to a similar position on the same road at Vancouver, B. C., and Mr. M. J. Scott, formerly master mechanic at Revelstoke, B. C., succeeds Mr. Main at Moose Jaw.

Mr. J. F. Bowden, formerly master mechanic on the Baltimore & Ohio at Newark, Ohio, has been appointed superintendent of motive power at Wheeling, W. Va., succeeding Mr. G. A. Schmoll. Mr. Bowden has been employed in the mechanical department of the road nearly thirty years.

Mr. J. L. Cunninghame, formerly master mechanic of the New York, Philadelphia & Norfolk at Cape Charles City, Va., has been appointed master mechanic of the Wilmington division of the Philadelphia, Baltimore & Washington, with office at Wilmington, Del., succeeding Mr. C. G. Turner, resigned.

Mr. J. F. Graham has been appointed superintendent of motive power of the Oregon-Washington Short Line with office at Portland, Ore., and Mr. J. F. Langley has been appointed assistant superintendent of motive power on the same road with office al-o at Portland, and Mr. F. A. Leavitt has been appointed general foreman on the same road with office at Albina, Ore.

Dean W. F. M. Goss, of the College of Engineering, University of Illinois, has been unanimously elected chief engineer of the committee on smoke abatement and electrification of railway terminals of the Chicago Association of Commerce. Dean Goss succeeds Mr. H. C. Burt, who died recently. Professor Goss has been granted a leave of absence from the University for a year.

Mr. W. S. Butler, formerly master mechanic of the Huntington division of the Chesapeake & Ohio at Huntington, W. Va., has been appointed master mechanic of the West Virginia general division with office at Hinton, W. Va., and Mr. C. B. Hitch, formerly general foreman on the same road at Covington, Ky., has been transferred to a similar position at Hinton, W. Va.

Mr. C. W. Allen, who has been vice-president of the Bordo Company of Philadelphia for the past seven years, has resigned. Mr. Allen was raised on the Reading, where he worked for 18 years, his father having been a master mechanic on that road. Mr. Allen has a very wide acquaintance among railroad officials which will make him a valuable agent for any railroad supply concern. His address is Reading, Pa.

Mr. W. F. Kaderly, heretofore superintendent of motive power of the Georgia Southern & Florida, has been appointed general superintendent of this road, the position being recently created, and Mr. J. A. Reed, formerly general foreman of the Georgia Southern & Florida, has been appointed master mechanic, with headquarters at Macon. The position of master mechanic was established upon the recent promotion of Mr. W. F. Kaderly, from superintendent of motive power to general superintendent.

The following appointments have been made in the mechanical department of this railroad, effective August, 1913: Mr. G. T. Depue, appointed shop superintendent, Galion, Ohio. Mr. C. A. Kothe, appointed master mechanic of the Cincinnati Division, with headquarters at Marion, Ohio. Mr. C. H. Norton transferred to general foreman, Huntington, Ind. Mr. A. J. Davis transferred to general foreman at Hornell, vice C. H. Norton. Mr. L. J. Malcolm transferred to general foreman at Salamanca, vice A. J. Davis. Mr. W. H. Sholl, roundhouse foreman, Hornell, vice L. J. Malcolm. Mr. J. E. Anderson, general roundhouse foreman, Susquehanna, vice W. H. Sholl, and Mr. J. H. Winfield, general foreman, Croxton, N. J., vice C. A. Kothe.

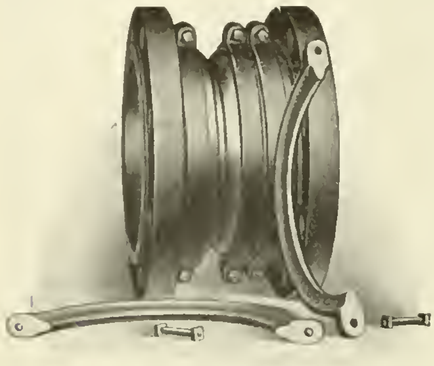
Mr. W. D. Holland, the well-known master mechanic, who has a tendency to take employment in strange countries, returned a few months ago for a sojourn in Haiti. He went to the Roosevelt Hospital in New York and had a surgical operation performed, made necessary by an accident he met with in a train wreck. After recovering from the effects of the operation he went to Moberly, Mo. to visit relatives and we expected that he would remain in the West all summer, but we have just received word from Mr. Holland in London that he is on his way to China. When Mr. Holland gets settled on any railway, no matter where it may be located, and needs to order railway supplies or equipment, he always uses the advertising pages of RAILWAY AND LOCOMOTIVE ENGINEERING as a guide. Many of our advertisers have been surprised to receive orders from out of the way countries, and never found out that Mr. Holland had copied their addresses from our pages.

Officers of the Traveling Engineers' Association.

The officers elected at the 21st Annual Convention for the ensuing year are F. P. Roesch, president; Robert Collett, 1st vice-president; J. C. Petty, 2d vice-president; J. W. Hardy, 3d vice-president; D. Meadows, treasurer; W. O. Thompson, secretary; W. C. Preston, W. H. Corbett, J. R. Scott, W. C. Hayes, H. F. Henson and Martin Whelan, executive committee.

The Badger Self-Equalizing Expansion Joint

The Badger Self-Equalizing Expansion Joint is a corrugated copper joint having external rings. It is designed to take up changes in length in pipe lines, whether these pipe lines convey steam, water or air.



JOINT WITH RING REMOVED.

Probably every engineer has had experience with the irresistible strains in pipe lines caused by expansion and contraction. Loose, leaky fittings and perhaps here and there a fractured joint point conclusively to the necessity for some device having sufficient flexibility to absorb these changes in length. The engineer also knows that the amount of change in pipe length depends upon two factors—the length of the pipe and the difference in temperature.

Although old-fashioned bends and long sweeps and loops are useful in making changes in direction and have been used quite extensively for taking care of changes in length, they are not beautiful and they take up considerable valuable space; also cracks are liable to develop under repeated temperature changes. The slip joint has the one disadvantage of requiring frequent packing.

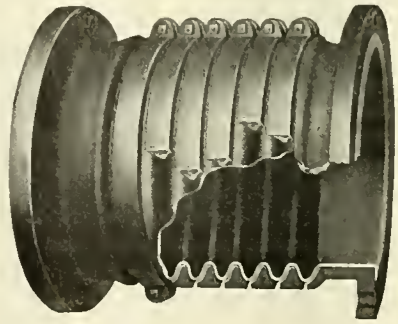
The Badger joint combines the elasticity to stand repeated changes of shape

JOINT WITH RINGS IN PLACE.

with strength to resist any pressure for which the joint is designed. The well-known corrugated form such as used for furnaces of internally-fired marine boilers is adopted because of its strength and flexibility. But a single piece of copper would have to be very thick for high pressures, and in actual practice it is found that there is always a tendency for one or two corrugations to take the entire strain of repeated change in shape. In time those few corrugations taking all the work would give out.

External rings on the corrugations of the Badger joint distribute the strains among several corrugations, and by thus bringing many corrugations into service no one of them is called upon to take more than its share of the work. The external rings force a part of the strain to the next corrugation, and as each corrugation has but slight movement, the joint lasts almost indefinitely. The external rings give added strength to the joint in the same way that spiral winding of a pipe with wire adds to its strength.

The number of corrugations depend upon the pressure and upon the length of the joint. For high pressures and su-



JOINT PARTLY IN SECTION.

perheated steam the change in length is considerable; therefore more corrugations are used. For very low pressures, as in exhaust piping, two or three corrugations are sufficient for the slight alteration in length. There are even some cases where the expansion is so little, that the joint does not need any rings. But in most cases external rings are used both to add strength for high pressure and also to stiffen the exhaust pipe against collapse.

The Badger Expansion Joint, which is made by the E. B. Badger & Sons Company, 63-75 Pitts street, Boston, is made in a complete line of sizes for all pressures and with flanges drilled to A. S. M. E. standards, both high pressure and extra heavy pressure. These joints require no packing and take up no more room than a pipe fitting. For low pressure work they have been made up to 6 ft. in diameter and have been made oval, rectangular, circular and in special forms. Special designs to suit any degree of curvature or other condition may be arranged at short notice by the expert engineers in the employ of the company.

George Westinghouse on Fast Trains.

We believe that the views of Mr. George Westinghouse on train speeds, and how safe train operating may be maintained, are more worthy of serious attention than the views of any other public man on that important subject. Under the caption of "Brakes and Collisions," the following letter contributed by Mr. Westinghouse has appeared in the New York *Times:*

The Coroner's verdict exonerating the New Haven Company and Engineer Dougherty from responsibility in connection with the rear-end collision at Stamford takes no note of the part the public plays in the matter of railway safety.

Railway officials are criticised by the public and various constituted authorities if trains are late, with the result that pressure is put upon operating officials, and through them upon employees, to bring trains into terminal stations on time. There is also a general feeling among railway managers that a public demand exists for fast service which, in the judgment of some of them, not infrequently calls for dangerous speeds. In the case under discussion both sections of the train were late, and the speed of the second section was undoubtedly very high. I have been informed, and believe it to be true, that some of the New Haven expresses between Boston and New York are scheduled at over seventy miles an hour on certain portions of the line in order to complete the journey in five hours. On this assumption it is not unlikely that speeds as high as eighty or even ninety miles an hour are sometimes reached.

EFFECT OF BRAKES ON EXCESSIVELY HIGH SPEED.

When emergency brakes are set upon a train running at the rate of eighty miles an hour that train is still running sixty miles an hour 1,100 feet from the point of application, whereas, if the train had been running at sixty miles an hour, it would have stopped in 1,100 feet. This demonstrates the greatly increased risk of accident due to high speeds, and also suggests the complications encountered in providing a signal system that will furnish adequate protection as compared with what would be possible if maximum speeds were limited to something like sixty miles per hour. The same difficulties will extend to any kind of automatic train stops, the demand for which, upon the part of the press and the public, has been so urgent.

PUBLIC DEMAND FOR STEEL CARS.

The public demand for the substitution of steel for wooden cars has been so insistent that the New Haven has already ordered a large number and has many now in service. That their introduction

has been a distinct advance in many ways is not questioned; nevertheless, trains are about thirty per cent. heavier, due to the use of steel equipment, and this excess weight is an element of danger in cases of collision, because of the increased momentum of the heavier trains. This heavier equipment also increases the cost and difficulty of track maintenance, and track imperfections are a common cause of accidents.

EFFECT OF COLLISION AT VERY HIGH SPEED.

In the Stamford accident an older car constructed of wood behind steel cars was crashed into by a heavy locomotive and the destruction which resulted has accentuated the demand for the heavier and safer cars. In an accident on a Western railway great damage was done by a wooden car being forced through the end of a steel car. As a matter of fact, if a train could be so solidly constructed that there would be no telescoping, then the impact of collision at high speed would be of such force that the occupants of the colliding trains would be injured, and probably many of them fatally, whereas, if a portion of the train yields or is crushed, the effect is to lessen the blow upon the remaining cars of the two trains involved, so that but few people in the remaining cars are injured.

The subject upon which I am writing has become so involved that in a letter of moderate length it is impossible to cover details essential to make clear the necessity that exists today for a readjustment of the ideas of the traveling public with regard to the composition of trains, their speed, signaling systems, automatic stops, and other detail features of transportation so freely dealt with by the press.

RAILWAY MANAGER WHO AVOIDED RIDING ON FAST TRAINS.

An official of one of our great railways said he never traveled upon the eighteen-hour trains which ran between New York and Chicago, always prefering a slower and more comfortable train. Such an opinion accentuates the importance to the public of their being satisfied with rates of speed which will insure safety as well as comfort.

LIMIT SPEED OF TRAINS.

The conclusion that one familiar with the problems involved inevitably reaches is that the first and greatest step to be made in the direction of safety is the limitation of the maximum allowable speed of trains, and to this end locomotives must be fitted with speed indicating and recording apparatus to show engineers the speed of the trains and furnish the operating officials a graphic record of such speeds. Such a device is available, and can be combined with an effective automatic apparatus to apply brakes when the maximum allowable speed is exceeded. Such speed limitation would enable signal engineers to arrange their signaling apparatus to be much more protective than when there is no speed limitation, and this lower and safer speed would greatly reduce the destructive action of heavier trains upon the permanent way.

It seems to me the time has arrived when the Interstate Commerce Commission, in co-operation with the managers of important railways, should make a careful and painstaking investigation of the subject of the safe operation of railways as influenced by modern equipment, high speeds, and other features, so that an authoritative report will very largely influence the traveling public in its attitude toward the great transportation properties of the country. In a recent decision of the California Railroad Commission I note the following two sentences:

If the installation of these devices requires an increase in rates, the increase will be allowed.

The traveling public has a right to be protected and should be willing to pay for such protection.

If the suggestions contained in this communication call for additional expenditure, the public cannot reasonably demand such expenditure by the railways without being willing at the same time to pay a just price for the introduction of such improved devices and methods.

A Poser for Pa.

It was a dull, wet evening, and little Vera was in one of her worst and most inquisitive moods. Father, busily writing at his desk, had already reproved her several times for bothering him with useless questions. "I say, pa, what———" "Oh, ask your mother." "Honest, pa, this isn't a silly one this time." "All right, this once. What is it?" "Well, if the end of the earth was to come, and the world was destroyed while a man was up in an aeroplane, where would he land when he came down?"

Nothing Nefarious About Him.

One day a man was brought before a magistrate for stealing a cheese from a grocer's door, and the principal witness, a carter, told how he had seen the man take the cheese and had run up and held him. "Then you caught him in the nefarious act?" said the magistrate. "The what, sir?" said the witness. "You caught him in the nefarious act, I say," repeated the magistrate. "Not me," was the reply. "I caught him by the scruff of the neck!"

RAILROAD NOTES.

The Chicago, Burlington & Quincy is inquiring for 50,000 tons of rails.

The Norfolk & Western is in the market for 10 Pacific locomotives.

The Chicago & Illinois Western is in the market for 250 gondola cars.

The Chicago, Milwaukee & St. Paul is said to be in the market for 70,000 tons of rails.

The Canadian Northern is in the market for 15 consolidation locomotives and 15 switching.

The Denver & Salt Lake is said to have ordered 175 box cars from the Pullman Company.

The Pere Marquette has ordered 10 Mikado locomotives from the Baldwin Locomotive Works.

The Paulista Ry. of Brazil has ordered 2 prairie locomotives from the Baldwin Locomotive Works.

The Canadian Northern is in the market for 15 consolidation locomotives and 15 switching locomotives.

The San Antonio & Aransas Pass has ordered 8 consolidation locomotives from the Baldwin Locomotive Works.

The Sandy River & Rangeley Lakes has ordered a six-wheel switching locomotive from the Baldwin Locomotive Works.

The Pennsylvania is said to be considering its 1914 rail requirements. The preliminary estimate is about 180,000 tons.

The Nigerian Railways of Africa have ordered 2 six-wheel switching locomotives from the American Locomotive Company.

The Hocking Valley has ordered 6 Mikado locomotives and 2 ten-wheel locomotives from the American Locomotive Company.

The Erie has ordered 40 Mikado locomotives from the American Locomotive Company, and 10 Pacific type from the Baldwin Locomotive Works.

The Norfolk & Western has ordered 26 130-ton electric locomotives from the Westinghouse Electric & Manufacturing Company.

The Gulf, Colorado & Santa Fe has let contracts for a 12-stall brick and concrete roundhouse, a machine shop 60 x 80 ft., and a power house 37 x 80 ft. at Brownwood, Tex.

The Erie, it is reported, has ordered 40 Mikado locomotives from the American Locomotive Company and 10 Pacific type locomotives from the Baldwin Locomotive Works.

The New York, New Haven & Hartford is reported to be in the market for 100 coaches, 50 smoking cars, 10 combination baggage and mail cars and 10 combination baggage and smoking cars.

The Wheeling & Lake Erie has prepared plans for freight sheds, station, machine shop and roundhouse at Zanesville, O. Action by the road depends on abandonment of a street by the Zanesville City Council.

The Southern has ordered 800 gondola cars and 500 hopper cars from the American Car & Foundry Company, 400 gondola cars from the Mt. Vernon Car Manufacturing Company, and 150 stock cars from the Lenoir Car Works.

The Monongahela has ordered 6 consolidation locomotives from the American Locomotive Company. The cylinders will be 21 ins. by 30 ins., the diameter of the driving wheels will be 51 ins., and the total weight in working order will be 194,000 lbs.

The Maine Central R. R. is in the market for 2 60-foot steel baggage cars, 2 66-foot steel combination baggage and mail cars, 2 60-foot steel postal cars, 6 67-foot steel coaches and 3 67-foot steel smoking cars.

The New York, New Haven & Hartford R. R., on August 24 will set in service a new electric interlocking plant at Worcester, Mass., where the Boston & Albany R. R., Boston & Maine R. R. and the New Haven have a junction point.

The Boston & Albany has ordered four six-wheel switching locomotives from the American Locomotive Company. These locomotives are to be equipped with superheaters, will have 21 in. x 28 in. cylinders, 57 in. driving wheels, and in working order will weigh 170,000 lbs.

The Hocking Valley has ordered 6 superheater Mikado locomotives, with cylinders 29 x 28 ins., a weight of 323,000 lbs., in working order, and 2 superheater 10-wheel locomotives, with cylinders 21 x 26 ins., a weight of 188,000 lbs. in working order, from the American Locomotive Company.

Books, Bulletins, Catalogues, Etc.

The Locomotive Furnace.

By J. T. Anthony and John P. Neff.

We have received from the American Arch Company, New York, a remarkably handsome catalogue bearing the above title. It contains some clearly written articles on combustion that will be read with profit by every person interested in firing locomotives. There are 14 beautiful illustrations of locomotive furnaces and their attachments. We understand that any person interested in firing locomotives can have a copy of this catalogue free on making application to the American Arch Company, 30 Church street, New York.

Laying Out for Boiler Makers.

Above is the title of a most elaborately illustrated volume, 13 x 10 ins., and containing 305 pages. The following are some of the subjects treated and they will give the reader some idea of the scope of the book: The subject of laying out; Triangulation; How to lay out a tubular boiler; How to lay out a locomotive boiler; How to lay out a Scotch boiler; Repairing locomotive and other types of boilers; The lay out and construction of steel stacks; Miscellaneous problems, etc. The writer endured some experience as a boiler maker and was constantly searching for information concerning the art and found very little information from publications. This book would have been of substantial help and we almost envy the ambitious young boiler makers who come to have such valuable help within their reach.

The book is for sale by the Aldrich Publishing Company, New York. Price, $5.

The Virginian Mallet.

A very interesting Bulletin No. 1014 has just been issued by the American Locomotive Company, 30 Church street, New York, giving a detailed description and record of the performances of the most powerful locomotive in the world. This remarkable locomotive has been occasionally referred to in our pages, and is a freight locomotive of the articulated compound type, having a tractive power of 115,000 lbs., and with the American Locomotive Company's system of compounding the tractive power can be increased to 138,000 pounds. Its continued service on the severe grades of the Virginian railway has demonstrated the great power as well as the economy of this type of locomotive in heavy freight service. Copies of the bulletin may be had on application.

Perfect Threads.

The National Machinery Company, Tiffin, Ohio, have issued an elegant descriptive catalogue showing details of tools used in producing their "Perfect Threads," and which were exhibited at the Master Mechanics' and Master Car Builders' Conventions at Atlantic City. The enviable reputation earned by the company is the result of long experience, and every year sees some marked improvement over previous years in their fine products. Their triple and quadruple motor-driven bolt cutters are among their more recent products, and a perusal of the catalogue, copies of which may be had on application, will show the details of other marked improvements in their machines.

Railway Routes in Alaska.

Part II. of the Report of the Alaska Railroad Commission, which was transmitted to the Congress last February, has just been issued and contains nineteen plates of maps and profiles embracing the proposed railroad extensions in Alaska. The report is a most important document, and with the accompanying maps presents a convincing proof of the amazing possibilities of the future of Alaska. Copies of the documents may be had on application to the Committee on Territories, Washington, D. C.

Information for Exhibitors.

The Panama-Pacific International Exposition Company has issued a bulletin of information for exhibitors, giving a brief description of the Exposition, extracts of important rules and regulations, and an analysis of the plan and scope of the exhibit departments. Copies of the rules and regulations, classification of exhibits, blank applications for space and other information for the guidance of exhibitors will be forwarded on request.

The Kennicott Company.

Mr. Elbert Hubbard, the popular writer, has recently made a visit to the plant of the Kennicott Company at Chicago Heights, Ill., and has written a book describing in a very attractive way the water softening processes which has been brought to a high degree of perfection by the enterprising company, and has met with much popular approval in almost every country in the world. All interested in the subject may have a copy of the book sent to them on application.

Starrett Tools.

The new catalogue No. 20, issued by the L. S. Starrett Company, is probably the most complete catalogue of mechanics' fine tools ever printed. Year by year the Starrett Company has built up its catalogue until this, the twentieth edition, is a large book in itself. It contains some 320 pages of interesting descriptions, illustrations, and prices for all kinds of tools for machinists, carpenters, draftsmen, engineers, chauffeurs, and other mechanics. In addition there are many pages of data and tables such as metric conversion tables, decimal equivalents, weight computing tables, tapers and angles, wire gage tables, etc. The arrangement of the catalogue has been somewhat changed from that of No. 19, which makes it easier for reference. There have been several important additions of tools to the Starrett line as shown in the new catalogue, and copies will be forwarded to any address on application.

Modern Railway Working.

A prospectus of an important work in modern railway working has just been issued by the Gresham Publishing Company, 11 Broadway, New York. The work is published in eight volumes, royal octavo, finely bound in cloth, and is sold in complete sets only. It is a practical treatise, by engineering and administrative experts, under the editorship of Mr. John Macaulay. The work deals largely with British railroad methods, but has also valuable data referring to other countries. The work would be an important addition to any railroad library.

Electric Headlights.

The Pyle-National Electric Headlight Company have issued an educational pamphlet on the subject of the Electric Headlights. Full instructions are given for applying the equipment and, after a perusal of the little book one knows all that is necessary to know in regard to the construction, application and proper focusing of the electric headlight. Attached to the booklet is a chart showing all the parts of the electric headlight named and numbered. Copies of this interesting work may be had from the company's general offices, Karpen building, Chicago, Ill.

Gold's Circulars.

The Gold Car Heating and Lighting Company has issued new circulars showing the latest improvements, including Gold's wedge lock steam coupler, comparative diagram showing the action of the Gold steam coupler's oscillating gasket and the non-oscillating gasket; also Gold's curtain window ventilator, Gold's thermostatic car temperature regulating system, Gold's simplex ventilated steam trap No. 912, and Gold's cut and valve No. 870. These devices are of exceptional merit, and the illustrations and descriptive matter fully and clearly point out their applicability to the best modern railway service.

Boring Head.

Marvin & Casler, Canastota, N. Y., has issued a handsome catalogue describing and illustrating the various forms and sizes of their new Offset Boring head, which is rapidly coming into popular favor. As is well known, the milling machine is vastly superior to the lathe for boring holes in jigs and irregular-shaped machine parts, but in the absence of tool-holders these offset boring heads meet all the imaginable requirements with additional advantages that are apparent at a glance. The ready adaptability of the cutters to be set at any desired point throughout the length of the bar has not hitherto been approached by any other boring bar. The catalogue furnishes full details, and copies may be had on application.

Carborundum.

Mr. F. W. Haskell has presented the story of Carborundum in a unique, illustrated booklet, that is of real interest, as it presents in a concise, graphic way the romance of the great modern abrasive. Those who think that they are familiar with the methods used in producing Carborundum will rub up against something when they read Mr. Haskell's booklet. It may be had for the asking from the Carborundum Company's general offices, Niagara Falls, N. Y.

Reamers and Sockets.

The Cleveland Twist Drill Company has issued a four-page folder, a kind of supplement to the company's elegant catalogue. The folder deals with the Peerless high-speed reamers, which, as has been proved, entirely eliminates breakage, and has the quality of expansion which greatly prolongs the life of the tool. The double tang sockets are also described, which in point of grip leave nothing better to be desired. In addition to these devices the Paradox adjustable reamers are shown. These reamers are fast growing in favor and are not only adjustable but are great savers, as they outlive eight or ten solid reamers before the first set of blades is worn out. Those who desire full details should send for copies of catalogues "No. 36," Price List "F-18" and "Catalogue No. 33," to the company's office, Cleveland, Ohio.

Fanaticism consists in redoubling your effort when you have forgotten your aim.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

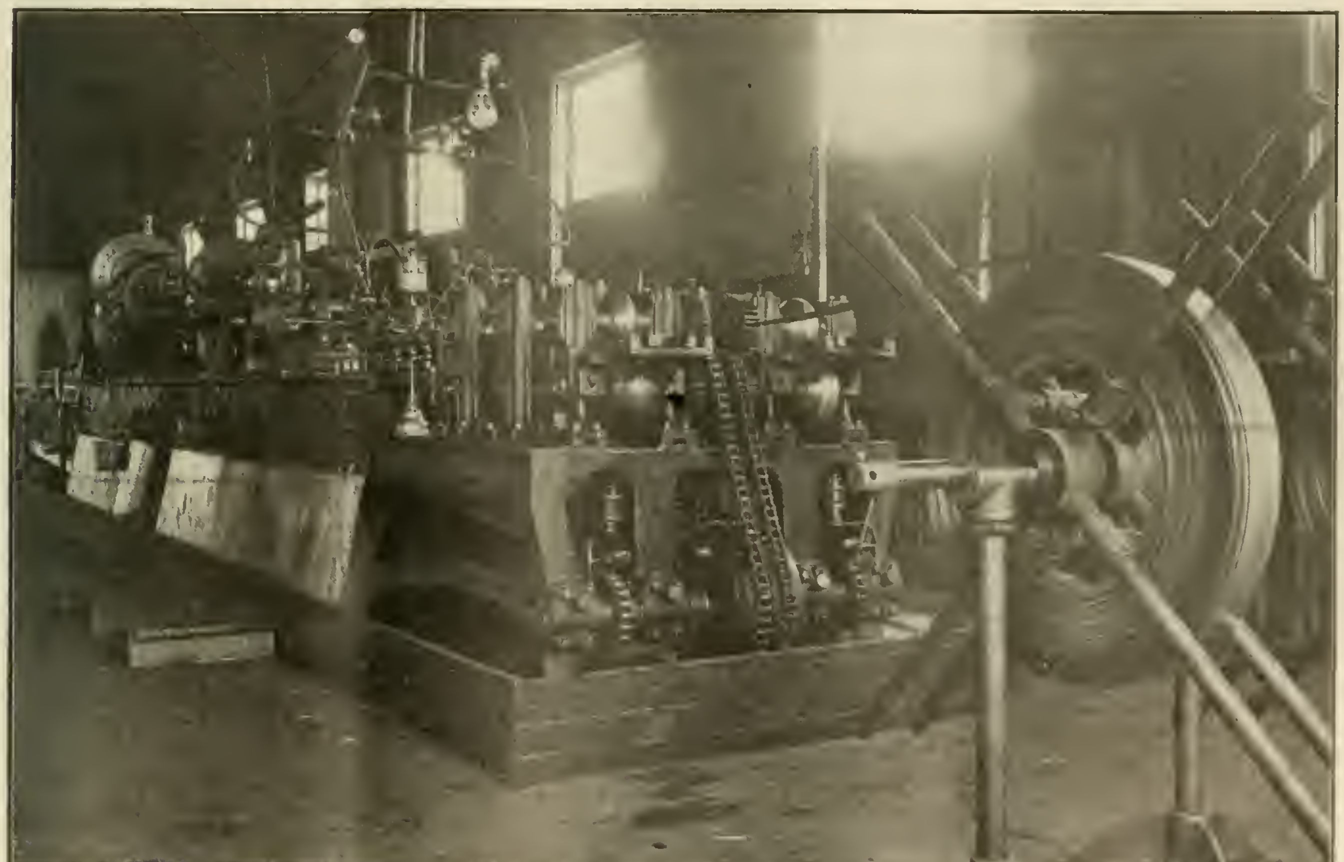
Vol. XXVI. 114 Liberty Street, New York, October, 1913. No. 10

Lloyd Seamless Steel Tube Mill

Among the more recent inventions that seem to bid fair to come into popular favor the Lloyd Seamless Steel Tube Mill is of particular interest. A number of representatives of seamless tube manufacturers inspected the new invention in operation in Detroit, Mich., last month, and the reports made by them are all of the most gratifying kind. The machine practically eliminates a large number of distinctive operations in the production of tubes, and combines all in one continuous operation without waste. If it proves successful as it promises to do, it will revolutionize the industry, in which there is now invested several hundred millions in manufacturing plants.

The machine is so compact it occupies only 3 feet by 20 feet of floor space. A double machine, producing two tubes at once, can be operated by two men. The hot or cold rolled steel is fed into the machine at one end, as shown in the accompanying illustrations, and the finished tubing comes out at the other end. Every step is automatic and radically different from anything now used—forming, welding, straightening, sizing, polishing, drawing and even cutting being performed by the machine without deterring the forward progress of the steel. The machine turns out the finished, polished tube at a rate of 4,000 feet a day in any size, weight, form or length desired.

The only waste in the entire operation is 1/16 of an inch in the cutting of the tube into the desired length. Present production methods incur waste of as high as 30 per cent. in some processes. The thinner the tube, the cheaper. This reverses the present best basis, which is based on the greater amount of labor required to draw the tubes to finer sizes. As the size of the automatically machined tube is determined by a simple adjustment of the machine, the material used alone regulates the cost. Uniformity of thickness, molecular tension, and resistance are assured, a variation of only .001 to .0005 inch in thickness was recorded by the micrometer in testing the tubes made by the machine while under inspection of experts.



LLOYD SEAMLESS STEEL TUBE MILL, SHOWING METAL STRIP ENTERING MACHINE.

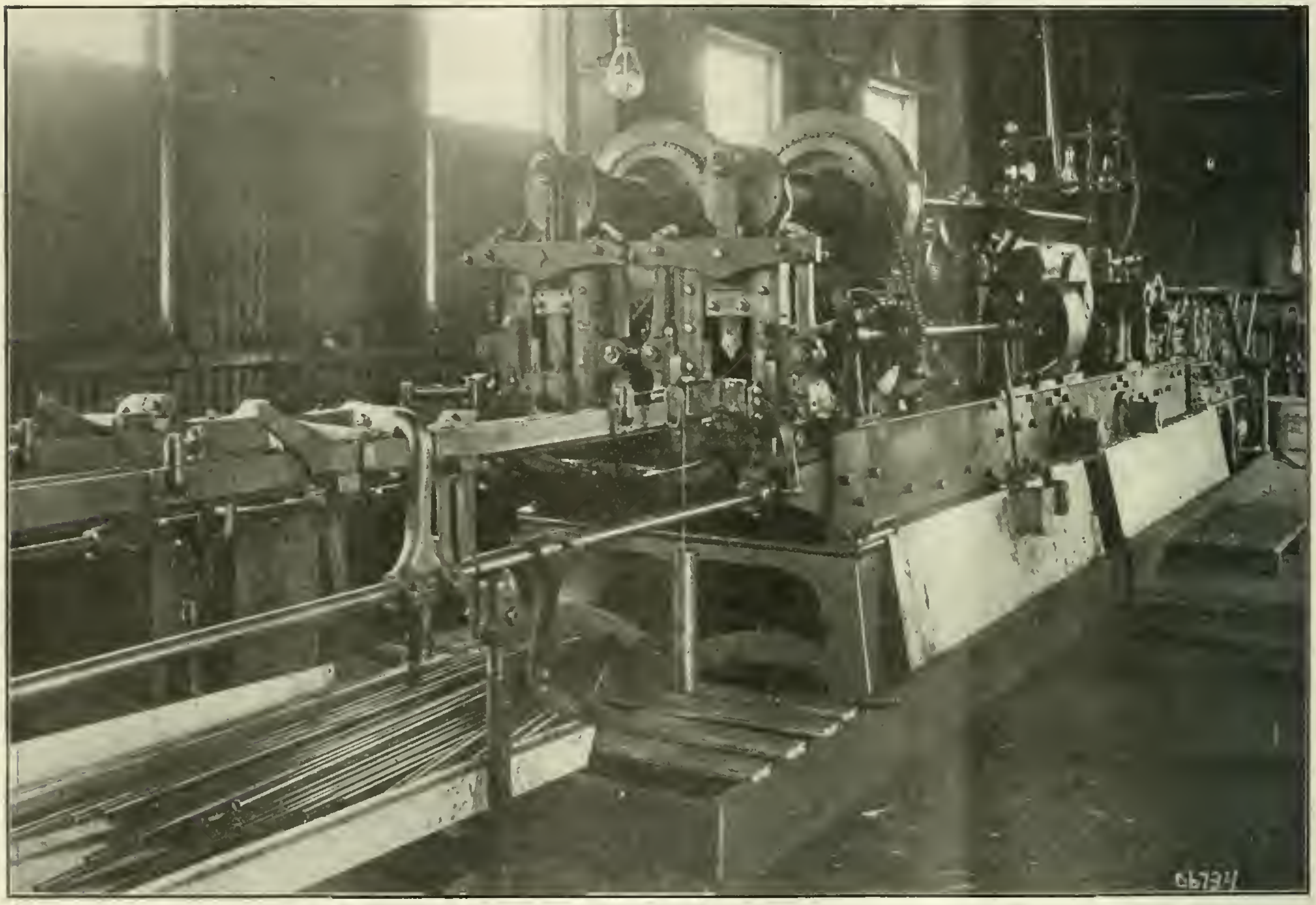
By ready adjustment, any desired shape

of tube is made; standard forms as oval, round, square, hexagon, etc., and irregular shapes, such as grooved round tubes for automobile wind-shields, etc. No additional expense is incurred in the production of the irregular shape; no more time is required for its production, and no special training in tube production is required in running a double machine. Tubing from 1 to 7 inches in diameter can be turned out by the standard machine by making adjustments, and extra large tubing can be produced by building a special machine.

It may also be noted that the method of threading the automatic tubing converts the weakest point of present tubing into the strongest point of that produced by the new invention. Instead of cutting threads into the ends of this tubing, the threading is built onto the ends of the new tubing, thus increasing its capacity to withstand pressure. In this connection, while a 10-gauge, 3½-pound pipe is tested at a water pressure of 600 pounds, the 20-gauge is tested at 3,000 pounds water pressure. Mr. Lloyd asserts that his lighter tubing will stand greater pressure than the heavier grades now used. The machine as demonstrated saves about 90 per cent. in labor in the production, and reduces the total cost of production by about 50 per cent.

In the process of manufacturing the tubes the flat metal strip is drawn through a series of small rollers to form it into the tube shape with a mandrel of peculiar construction on the inside. The tube emerges from these rollers to all appearances a seamless tube, the edges being even and tight. It then passes a device that holds the tube into position to be welded, the edges of the metal being melted by the use of gases. A small thin burr shows where the metal flowed together. This is removed with a knife and the tube is smoothed with a small emery wheel. It now passes into a large powerful vice with half-round jaws, continually traveling and gripping about 2 feet of the tube stock. This vice is as powerful as the ordinary draw bench and is virtually an automatic bench in itself. When it emerges from the vice, it is sized and polished by cold rolling with water. It then passes through a straightening device, without interfering with forward movement, is cut off and dropped into a receptacle on the floor. In appearance the tube appears to be nickel-plated, so smooth and bright is the polish.

One of the prominent tube manufacturers who had seen this process in operation said: "All the improvements in the history of tube making are only a trifle compared to the vast importance of what Lloyd has done. All I hope is that no one concern will ever obtain control of it. If the inventor carries out the plan on which he proposes to operate, namely, to license everybody who wants it, present prices of tubing will be cut in half. It will do for the tube industry what the cotton gin did for cotton and the reaper for agriculture. The saving in waste alone will mean a saving of millions a year to the tube industry."



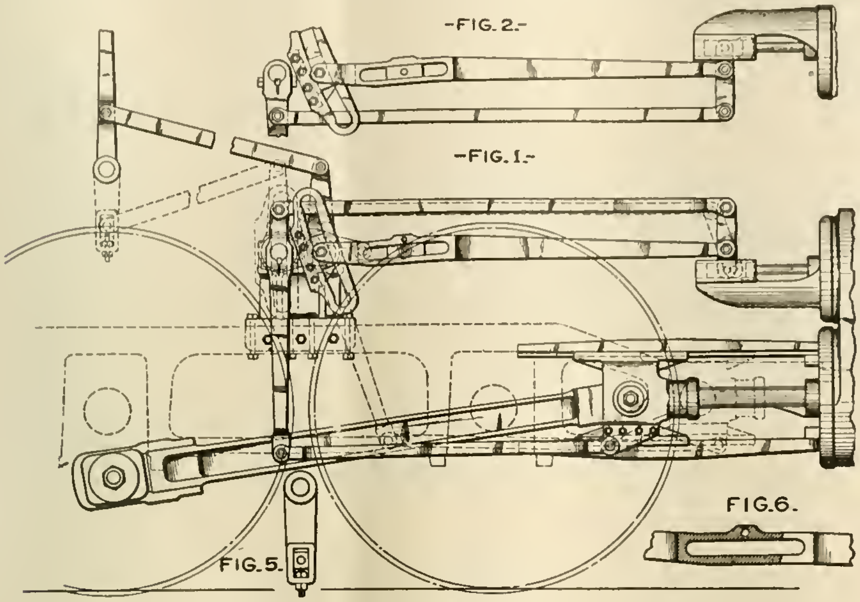
LLOYD SEAMLESS STEEL TUBE MILL, SHOWING FINISHED FLUES EMERGING FROM MILL.

Smoke Jacks.

At a recent staff meeting of the Erie Mechanical Department a report was made on Smoke Jacks, which showed that Lohmannized smoke jacks are the most durable of anything that has ever been tried. A roundhouse smoke jack has always been a very troublesome article to maintain, the acid from the smoke corroding the metal very rapidly. Renewing smoke jacks is a very troublesome operation and we feel certain that the use of Lohmannized metal in the construction of these jacks will soon become a regular practice. People who wish to adopt this improvement and wish to secure the metal should apply to J. H. Maddy, Lohmann Company, 50 Church street, New York.

Young's Steam-Engine Valve Gear

A patent has just been granted to Mr. Otis W. Young, Schenectady, New York, regarding an improvement in steam engine valve gear. The gearing is of the radial type, simple in construction, with few working parts, the motion being derived wholly from the movements of the engine pistons, thereby avoiding the distortions due to the slip of driving boxes, wear of journal brasses and settling of the engine upon its springs.



SIDE VIEW YOUNG'S STEAM-ENGINE VALVE GEAR.

In the accompanying drawings, Fig. 1 is a side view, in elevation, of the valve gear as arranged for the operation of inside admission valves on a locomotive engine; Fig. 2, a similar view of a portion of the same, as applied for the operation of outside admission valves; Fig. 3, a plan or top view; Fig. 4, an end view; Fig. 5, a side view of the lower arm of the reverse shaft, detached; and Fig. 6 a partial longitudinal section through a radius bar.

The movable members of the valve gear are mounted upon and carried by a support which is in the form of a cross tie or brace, bolted to the locomotive frames and projecting outwardly, a support being provided at its outer ends, with bearings in which are journaled two parallel rock shafts, located about eight inches apart. An operating combination lever is fixed upon one end of one of the rock shafts, and a segmental slotted reversing and cut-off varying link is fixed upon the opposite end of the shaft. A similar operating combination lever is fixed upon the end of the other shaft which adjoins the link, and a link is fixed upon the end of the shaft which adjoins the combination lever.

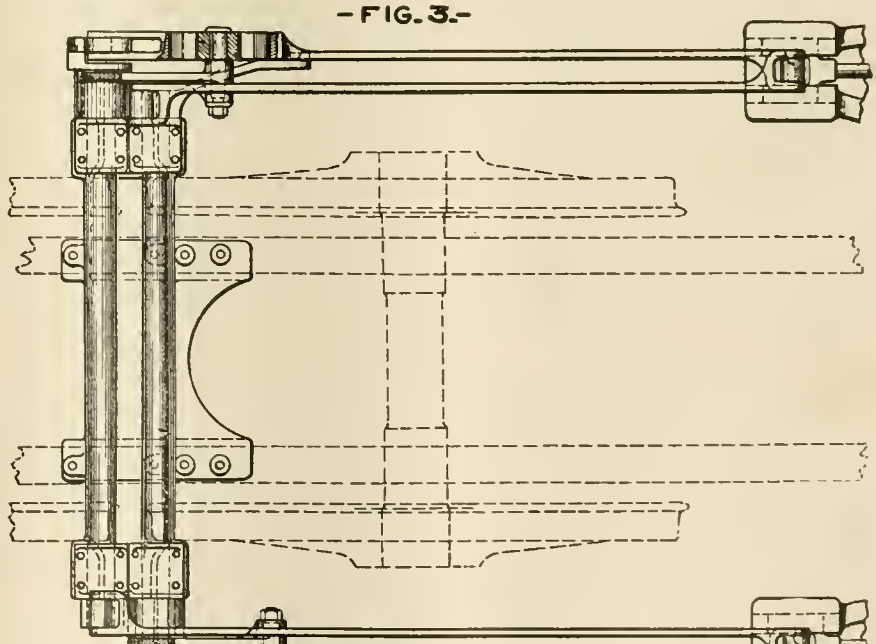
The combination levers have longitudinal slots cut in them, and are caused to grip the shafts by clamping bolts until the key way is properly located, when they are secured on the shafts by keys. The lower ends of the combination levers are coupled by links to the crossheads of the locomotive. The combination levers are coupled by lap and lead rods to floating levers, which are in turn coupled to crossheads, which work on guides fixed to brackets projecting from the valve charts, the crossheads being secured to the stems of the valves. The relative disposition of the lap and lead levers, radius bars and floating levers differ according as inside or outside admission distribution valves are to be actuated.

The upper arm of the reverse shaft is coupled by a link to the upper arm of a bell crank lifting lever, which is journaled on a hub fixed to the link and rock shaft, and the lower arm of the bell crank lever is coupled, pivotally, to a block fitted to slide in a straight slot formed in the radius bar.

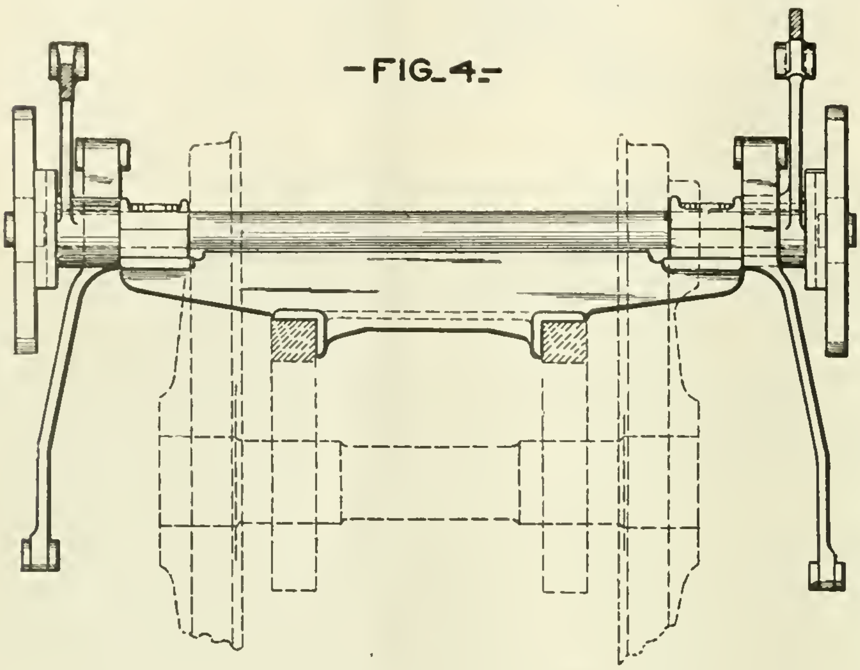
By connecting the radius bars with the reverse shaft on opposite sides of its axial line, the radius bars are caused to work adjacent to opposite ends of the links on opposite sides of the locomotive, so that when the right hand radius bar is at or near the top of the slot of the right hand link, the connection of the left hand radius bar is correspondingly at or near the bottom of the slot of the left hand link. One motion consequently balances the other, and the reverse lever is handled with perfect ease, without the use of any counterbalance spring.

Errors on account of the angularity of the main rod are entirely avoided. The gear is easily adjusted and remains perfectly square at every point. The leading characteristic feature of the invention consists in mounting a lap and lead lever, a link, and a reversing arm, upon a rock shaft which constitutes a common fulcrum for these movable members. The construction is claimed to be of substantial practical advantage, both in the matter

-FIG. 3.-


PLAN VIEW YOUNG'S STEAM-ENGINE VALVE GEAR.

of simplification and in insuring regularity of valve events, by automatically insuring uniform valve movement in all cases, for the reason that it entirely eliminates liability to error in properly locating the reverse shaft, which is one of the most serious sources of difficulty in the adjustment of the Walschaerts valve gear.



END VIEW YOUNG'S STEAM-ENGINE VALVE GEAR.

Machinery Exhibits Panama-Pacific Exposition.

Progress is being made in the construction of the main exhibit buildings at the Panama-Pacific International Exposition at San Francisco. The first of the buildings is now completed and five other structures are under way. There will be fourteen main exhibit buildings all told, and contracts will be let for the remainder, to bring all to completion by July, 1914. Work on the Machinery building, the largest of the exhibit group, was begun early in the year and the framing of the main portion of the structure is partly completed.

Early applications for space in the machinery exhibit, for which there is to be no charge, are especially welcomed by the Panama-Pacific management. The Machinery building will have nearly eight acres of floor space.

Copies of the rules and regulations, documents as to the classification of exhibits, blank applications for space and other information prepared for the guidance of exhibitors will be promptly forwarded on request to the Panama-Pacific Exposition Company, San Francisco.

The Largest Single Leaf Bascule Bridge in the World.

The bridge recently completed for the B. & O. Railroad across the Calumet River at South Chicago is the largest single-leaf bascule bridge in the world. The total length of span is 235 feet, the weight of the steel work is 1,300 tons, and the counter-weight 2,000 tons. This whole mass is moved in the remarkably short space of 1¼ minutes, control being effected from the operator's cabin in precisely the same way as a street car is handled and with no more trouble. The bridge was built in the open position, that is, the leaf was vertical, and traffic was maintained on the old structure while the new was in process of construction. After the entire structure had been completed in this position, it was lowered in place and was then found to be less than ⅜ in. out of alignment. The bridge is of the heel trunnion type. In this type, the leaf and the counterweight are separately mounted and are connected by a link forming part of a parallel link mechanism, the resultant action of the parts being that the center of gravity of the entire structure, that is, the leaf and counter-weight, moves neither vertically nor horizontally. Therefore, the only effort required to operate the structure is that necessary to overcome friction and wind resistance. Furthermore, the reactions on the piers are vertical and constant throughout the entire operation of the bridge, and the size of the piers is much smaller than has heretofore been possible in bascule construction. While the bridge is normally operated by electricity, a gasoline engine drive is provided for emergency operation.

Engineering Rivals of the Panama Canal.

The excavation of the Panama canal has been such a stupendous engineering enterprise that many people believe that it is the greatest undertaking ever achieved by the people of the United States, which is a mistake. The construction of many of our railways has entailed more labor than the digging of the Panama canal, and there are still several engineering enterprises lately finished and others going on that are good rivals of the canal that will join the waters of the Atlantic and Pacific. For one thing, the work going on on the Erie Railroad for the purpose of reducing grades, straightening out curves and double tracking, equals in magnitude the cutting through of the Panama canal.

Among other great undertakings that rival the Panama canal are the great power dam at Keokuk; the Erie or barge canal; the Cape Cod canal; links in the intercoastal chain; the dam at Minneapolis; and, not among the least, the canal that is to unite Lake Washington with Puget sound, thus giving Seattle twenty miles of wharfage room where it has only four miles now, have all been steadily prosecuted. Lake Washington has been for years one of Seattle's most charming resorts. It is a splendid body of water about twenty miles in length, lying close to the city. To connect it with Puget sound it is necessary to construct a canal of about eight miles in length, and this waterway, as now planned, will be of sufficient capacity to admit the largest vessels plying the Pacific. Of existing locks, that of this canal will be next in size, it is claimed, to those of Panama. It will have a length of 850 feet, a width of 80 feet, and a depth of 54 feet.

Longest Straight Railroad.

The longest stretch of railroad in the world without a curve is in New Zealand, where there is a distance of 136 miles in a perfectly straight line. This fact is remarkable, when it is taken into consideration that New Zealand is one of the most difficult countries in the world for railway construction, as it is very mountainous, necessitating sharp curves and very heavy grades.

Extending the Intercolonial.

Work was begun on the construction of the St. John Valley Railroad between St. John and Grand Falls, a distance of 218 miles. Although weather conditions were very unfavorable, material progress was made. Over 2,000 men were employed and $1,500,000 was expended. The contracts call for the completion of the principal part of the road, between Centerville and Gagetown, in November, 1913. The total cost of the road will be about $10,000,000, and it will be taken over and operated by the Dominion government as part of the Intercolonial System.

General Correspondence

Mr. George Westinghouse on Fast Trains.

Editor:

I have read with very great interest the views of Mr. George Westinghouse as expressed in your issue for September, page 338, and with which I entirely agree.

It will be remembered that about twenty-five years ago the "Railway Speed Craze" began in England. Competing companies reduced the time, first on one line and then on the other, until the running speed became highly dangerous, and passengers began to refuse to ride in the racing trains. The "speed craze" in England has passed away and the general public now thinks more of safety and a punctual train service.

In a journey of 300 or 400 miles, what possible advantage can it be to a passenger to know that he has arrived say 30 minutes earlier than the old timing?

To save this 30 minutes, excessive speed of perhaps 80 to 90 miles an hour has been run on some parts of the road. A large quantity of extra coal has been used and the wear and tear of both engine, cars and track has been considerably increased.

Railway travelling would be far safer and the trains would keep more "closely on time" if the speeds were not more than 60 miles an hour. Twenty years ago I travelled on the locomotives of some of the fastest express trains in America, and have in my note-book records of some wonderful locomotive work, but still, I am of opinion that the cost of working trains at excessive speeds seriously reduces the dividends which are paid to the railroad shareholders, and this is especially the case when a serious accident results from high speed. Therefore, I am of opinion that "Sixty miles an hour is plenty," and that those persons who wish to go faster better go in a "flying machine" and not on a railroad track.

Clement E. Stretton,
Member Society of Engineers.
Leicester, England.

Reaping the Whirlwind.

Editor:

A fierce editorial in the *Scientific American* of September 13, regarding the frightful disasters on the New Haven Railroad, attributes the cause to the policy under which the great system has been controlled during the past decade, and under nine separate clauses points out the defects that have brought about the series of disasters.

There is some, but not much, truth in the article. It has been said that even the fool is wise after the event. This is not always the case. Glimmerings of truth come from bitter experience, but not the whole truth. If this were not so, surely the New Haven managers would be wise men, and we would hear of no more disasters, but that there will be more disasters in the future is painfully evident to every railroad man familiar with the real causes that have led to such a sad series of calamitous occurrences.

In the article referred to the lack of improvements is the burden of the sad song. It is said that the road has in no way kept pace with the march of modern progress. This is a gross error. The New Haven has kept pace with the times —but only in spots. There would have been much less disaster if there had been less improvements. There were no such disasters in the records of the last century, when the locomotives were smaller and the trains lighter, and the air brake unknown. As the population grew denser and the traffic heavier, and as the locomotives wore out and their places were taken by heavier and better locomotives, the railroad remained about as it was, and the result of this incongruity in improvements could not be other than disastrous.

It may be said further that such improvements as have been made on the New Haven began at the wrong end. The motive power should not have been increased in weight and power until the maintenance of way department had advanced improvements in the roadway and appliances. In a country like that between New York and Boston, with a never ending chain of towns expanding into cities, there should now have been at least a continued four-track railroad equipped with every known safety device. It would have meant a large outlay, but other roads have met the demand in districts less favored, and with results alike gratifying to the promoters and the public. As it is, we see the humiliating spectacle of a great thoroughfare becoming a standing menace to human life, a decayed monument to the infamy of greed gone mad. We see clubs formed in some districts along the road where a number of people have cars of their own so constructed as likely to sustain a collision without the danger of immediate collapse, and thus a certain number of people of means may travel abroad armor-clad. This could hardly be called a pleasure excursion car, but rather a safety-first car. That haste will be made to remedy the sorry spectacle is evident, but it will take time, and, as already stated, more disasters may be looked for.

W. Richardson,
New Haven, Conn.

What Has Come Over the Corrugated Flue?

Editor:

At a meeting of the Master Mechanics' Association some years ago, a leading superintendent of motive power spoke in a highly eulogistic manner regarding the results obtained by the use of corrugated flues for locomotive boilers. He said that it had been found by practical tests when engines were equipped with corrugated flues that the mileage for fuel consumption of such flues was double that made by engines equipped by ordinary flues. Another advantage of the corrugated flue was that it materially reduced spark throwing.

These would seem to be very important savings attributed to the corrugated flue and it seems that all railroad companies would tumble over each other in the rush to secure corrugated flues for their engines. I have looked over locomotive specifications to find corrugated flues applied, but in vain. Was the corrugated flue that was so cordially praised a deception? Can you or any of your readers answer this question of an Anxious Inquirer?

A. Miller.
Elkhart, Ind.

Smokeless Firing—Does It Save Coal?

Editor:

A subject which you and your correspondents seem never to be tired of ventilating is smoke prevention, and you write as if the elimination of smoke from a locomotive firebox is as easy as falling off a log, and that smokeless firing means immense saving in the amount of coal needed to keep her hot, otherwise to maintain the required pressure of steam.

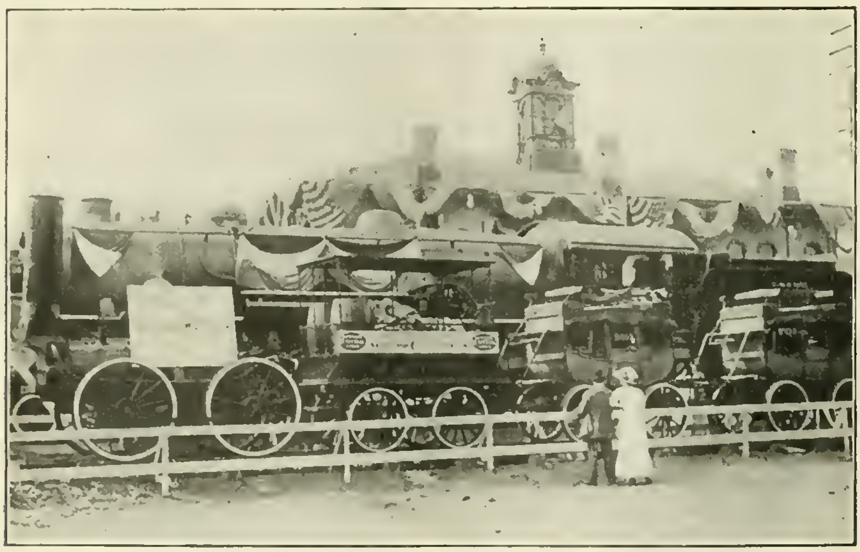
It has been my good fortune to work in laboratories where tests of coal were frequently made, and the highest number of heat units produced from a given weight of coal were obtained when the admission of air was exactly right to produce carbon dioxide, the hottest product of combustion. In cases where the

air admission was restricted, carbon monoxide resulted, which is deficient in heat, and when too much air was admitted there was waste from reduction of temperature. So the experimenters who were promoting combustion on a small scale were constantly in danger of producing waste of heat from deficiency of oxygen or a superabundance. They were constantly drifting upon Scylla on the one hand or on Charybdis on the other.

Now, when there is so much difficulty in regulating a small laboratory furnace to maintain perfect combustion of fuel, how can it be expected that the proper mixture of air which produces smokeless firing can be maintained with a locomotive furnace? We are told that absence of smoke means economical use of fuel, but I doubt it. On a certain railway where premiums were given for fuel saving, most of the locomotives were provided with openings for admitting air above the fire. It was a regular habit with the enginemen to close up these openings, because cutting off the supply of superfluous air resulted in saving coal, although more or less smoke was produced. These enginemen were not theorists, but they understood the condition that would maintain steam pressure with the smallest expenditure of coal.

Arthur Simms.

Philadelphia, Pa.



LOCOMOTIVES "DE WITT CLINTON," 1831, AND NEW MIKADO LOCOMOTIVE, 1913.

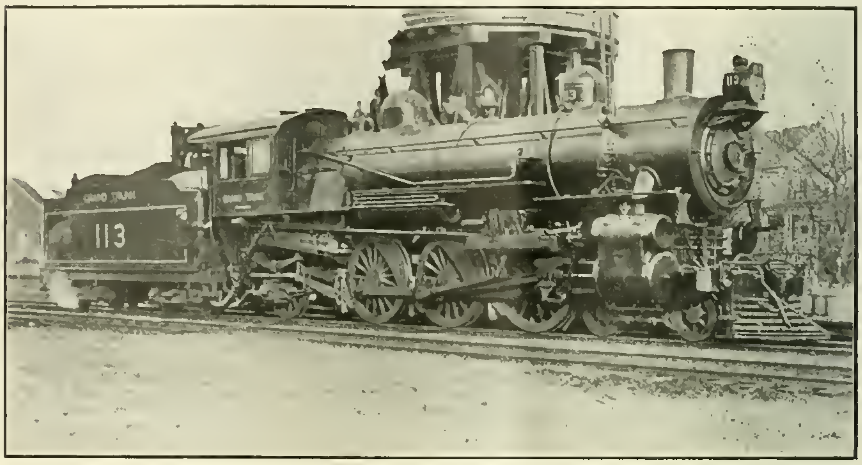
Photographs of Locomotives.

Editor:

Enclosed are ten photographs of various kinds of Grand Trunk locomotives, five of the Maine Central, two of the Portland Terminal Company, and one of the Boston & Maine. I have disposed of quite a large number of the photographs here, and if any of your readers are interested in adding to their collection, I will be pleased to furnish a set of the photographs to them at cost, which may be had on application. Should you find room to reproduce one of the photographs, perhaps the copy of the Grand Trunk Pacific type in the collection might suit as a sample. Your illustrations continue to be excellent, while the reading matter of Railway and Locomotive Engineering combines all of the best features possible in an educational and trade journal.

Edward L. Greene.

South Paris, Maine.



GRAND TRUNK LOCOMOTIVE OF PACIFIC TYPE.

A Century of Progress.

Editor:

At the Perry Centennial celebration, perhaps of equal interest with Admiral Perry's ship, was the exhibit of the New York Central Lines, embracing as it did the locomotive "De Witt Clinton," and the three original coaches, together with one of the New Mikado locomotives, No. 4014. The contrast was remarkable as showing the marvellous advance made in locomotive construction. The fine state of preservation of the famous old locomotive and coaches redounds greatly to the credit of the railroad company for the excellent care of what are now historic relics of early steam railroad transportation.

I recall seeing the autographs of the original passengers on a wood cut, showing the De Witt Clinton and the three coaches on their initial trip over the Mohawk & Hudson Railroad in 1831. The picture was exhibited in the museum at New Orleans, La.

Enclosed is a photograph of the exhibit.

Erie, Pa. A. M. Harris.

Steel Cars in Destructive Wreck.

Editor:

One day last month a bad case of derailment happened to a fast express train near New Madison, Ohio. Running at a terrific speed to make up lost time, the fast train struck the defective rail on the Columbus & Indianapolis division of the Pennsylvania Railroad, about fifty feet from the approach to a small steel bridge at the edge of Wylie's Station. The train ran along the cross ties until the engine hit one side of the bridge, tore its foundation and fell with it half a dozen feet to the creek bed. Six steel coaches were flung to the other side of the track and turned over in a cornfield, the first near the edge of the little stream. Two rear coaches—an observation dining car and a Pullman—remained upright on track bed.

None of the steel coaches was much damaged, but all were scarred by rails, ties and earth, and with comparatively little repair all can be replaced in service. Injuries to passengers were caused principally by falling and being thrown about in the coaches, though some were cut by flying glass.

Thirty-five persons were injured in this wreck but no person was killed. This is believed to be a striking proof of the increased safety that results from the use of all-steel cars.

J. T. Egan.

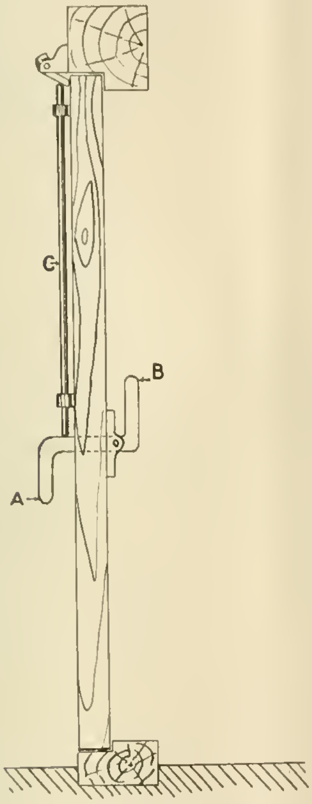
New Madison, Ohio.

Door Closing Appliance.

EDITOR:

Before the cold weather approaches it is well to remember that in a large number of railroad repair shops the shop doors give a great deal of trouble, especially where the carpenters have put on a cheap kind of closing appliance, which, after being a short time in use, does not keep the door securely closed.

The accompanying drawing shows a reliable door closing device which never fails to perform the duty expected of it. It has stood the test of several winters here and is still in excellent order. The contrivance is a very simple



DOOR CLOSING DEVICE.

one. To pass from inside to outside all that is required is to lift the handle A. Then the rod C rises and lifts the clutch to release the door so that it can be opened. The rod falls down by gravity when the door is closed. To pass from the outside to inside the handle B is pulled till the rod lifts the clutch, then a downward pressure and the door is opened.

The device has also the merit of puzzling those who endeavor to use it for the first time, and serves a good purpose in refusing admittance to visitors who are not accompanied by some one familiar with the simple contrivance. It takes the place of a perpetual watchman.

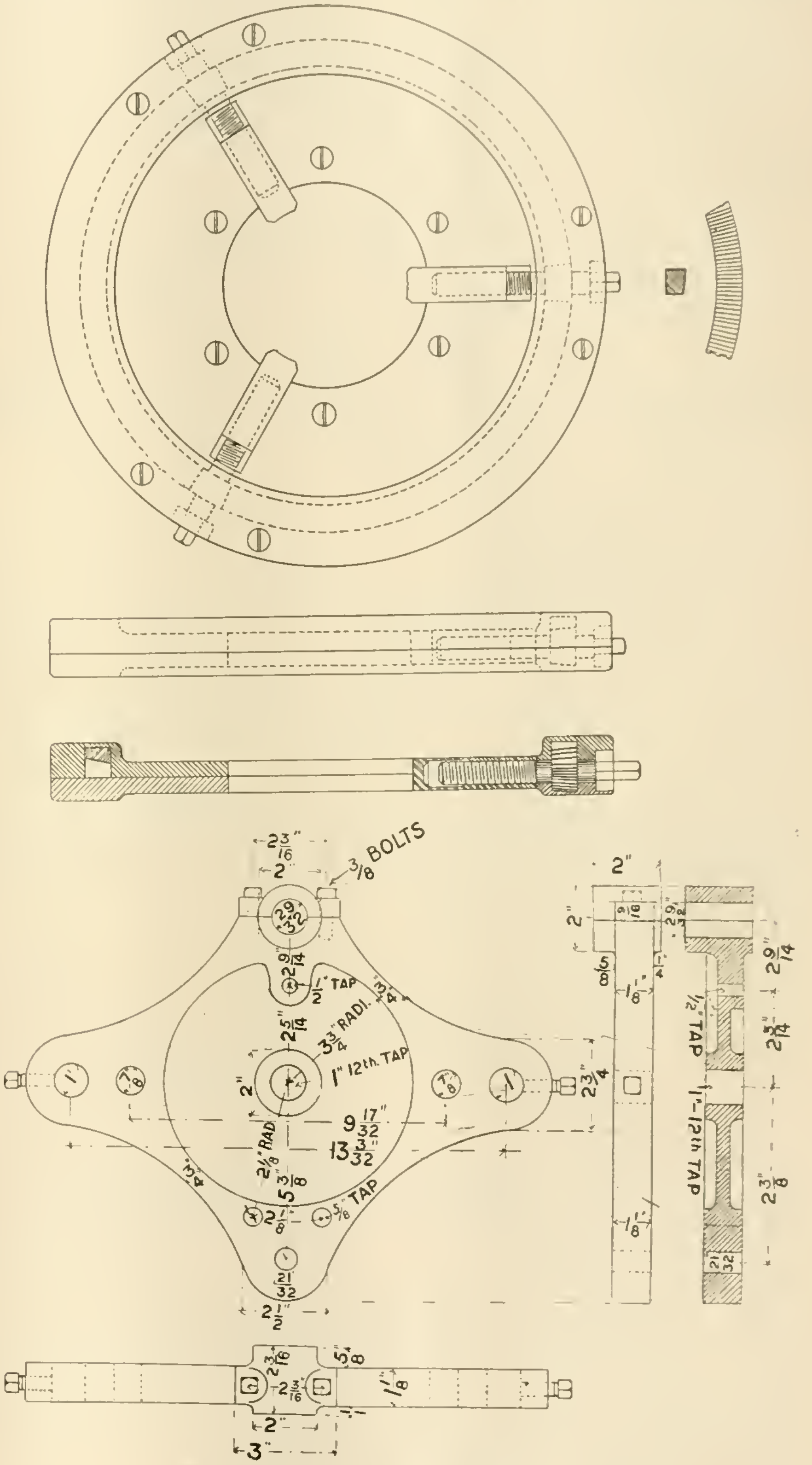
J. G. KOPPELL.

Montreal, Canada.

Car Axle Turner

By CHARLES MARKEL, Clinton, Iowa

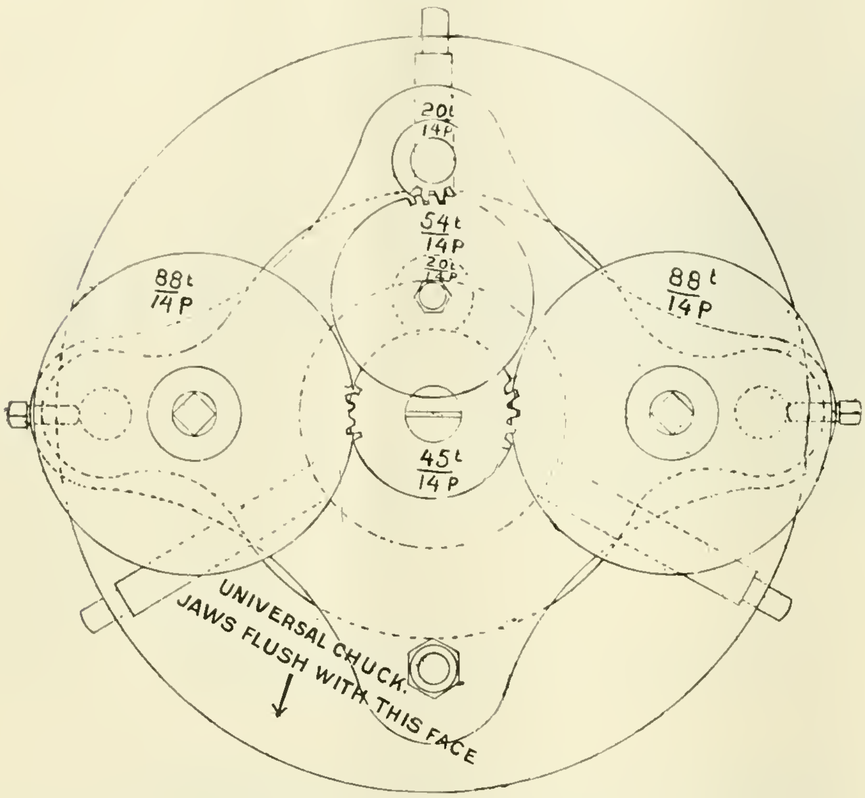
The accompanying drawings show a car journal turner that was designed and used at the Clinton car shops with journal on track instead of taking the axle and attached wheels to the shop and turning the journal in the lathe.



UNIVERSAL CHUCK AND ADJUSTABLE CENTER.

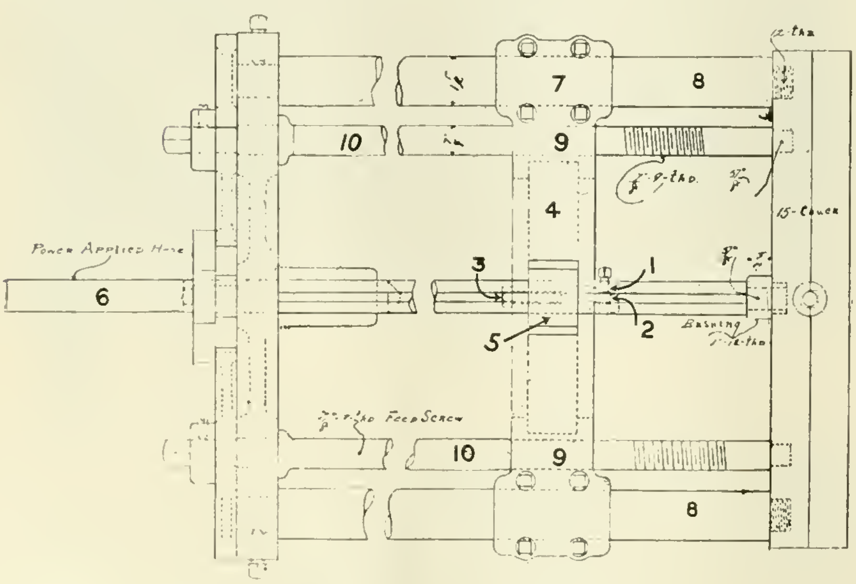
good results. This appliance was constructed for the purpose of being used in car yards by simply removing the wheel from the truck and then turning the It has been found to do rapid and accurate work and soon pays for itself, and would pay any company for its construction, in a short time, who are

now conveying wheels to the machine shop to turn the journals. This portable turner is quickly set by a three-jawed universal chuck on one end which grips the turned part of the axle next to use a speed reducer on the machine, as the speed was too fast when acting directly from the air motor. The drawings show the details of this reducer, and it may be added that the cutting



SPEED REDUCER ON CAR AXLE TURNER.

to the wheel. This has the effect of centering that part of the machine. The outer end is centered by an adjustable center which takes its center tool is carried on the outside edge of the large gear wheel, which wheel revolves around the axle or journal to be turned. The tool post is shown at



PLAN OF CAR AXLE TURNER.

from the center of the axle, thus setting the machine exactly central with the original turning of the axle.

In operation we found it advisable figure "1" in the last drawing. This holds the ⅜-inch square tool in slot at "2," and when the tool is adjusted it is held from moving by tightening tool post nut "3." The large gear wheel which carries the turning tool is marked "4," and is driven by pinion "5," which is attached to shaft "6" and when power is applied to this shaft "6," it revolves large gear wheel "4" that carries the cutting tool around the journal. The feed of the tool is procured as follows: Crosshead "7" is carried by two guides "8." The crosshead is tipped out ⅞ inch for feed screws at "9." The feed screws "10" are threaded the full length of guides, and are fed by gears as shown in front view of the machine. The pinion of 20 teeth drives pinion of 54 teeth, and on this shaft is a pinion of 20 teeth driving one of 45 teeth, and this drives two pinions of 88 teeth which are fastened to the two feed screws "10," which motion feeds the tool along the journal. This view also shows the ends of the feed screws squared for wrench which quickly advances the crosshead to either end of journal.

Why So Many Fail as Engineers and How to Succeed.

By C. D. George.

We are asked, "Why do so many firemen fail to obtain promotion to engineers? or having passed the required examinations, fail to render the efficient service due their employers from one filling so important a position?"

Two words will answer the question, procrastination and disinterestedness, which are the direct result of conditions resulting from schedules which remove from the required duties of engineers and firemen the work on and around the engine, through the performance of which the embryo engineer (fireman) must necessarily become familiar with the name, appearance, location and adjustment of the various appliances and mechanisms about the engine.

This "disinterestedness and procrastination" is also given new life by a laxity in method of calling men in for their examinations, which are lacking in thoroughness relative to the construction and operation of the most important appliances and mechanisms and the methods of overcoming defects in the safest manner, as well as quickest possible time, by utilizing brain instead of brawn.

The fault may be attributed, to a certain extent, to the heads of departments (who, through a false sympathy, or fear of dearth in men fitted to fill positions) do not require men to be thoroughly posted in all matters pertaining to mechanisms placed in their hands, and to the proper performance of duties devolving on them in service, assuming that the men will make an especial effort, after promotion, to acquire the information necessary to make them profitable and efficient servants, and the delusion is in-

variably dispelled by "man failures" and the blame for the failure is placed by the public on the official head of this man's department.

The result of dilatory manner of calling men in for examinations, and laxity in requirements for qualifying in the examination, is that the men look on the examination as a sort of a joke, and consequently during their period of apprenticeship (firing term) they make an indifferent effort to gain the information which will enable them (to use the common expression "to get by" the examinations, and then when the examinations are "gotten by" and they are placed in charge of an engine, we hear them saying, "What do I need to study or bother my head for? I am promoted, I am as high as I can get in line of promotion, and I had ought to be as lucky as John Jones; he has run an engine for forty years and had good luck." And his work with the resulting trips up on the carpet, shows the trend of his mind. Six weeks after promotion 90 per cent. of these men could not "get by" the examination again if they were unexpectedly called up for it, because they have put off being interested in their work any more than to get in the time and draw the salary. Hypnotizing themselves into believing that they have "got lots of time," as they are pleased to term it, because, "Bill Smith passed and he does not know any more than I do, the examinations are easy, and what I don't know the road foreman of engines will tell me, they need the men and cannot turn me down," as the time for examination draws near, and it is almost too late, they will resort to strenuous methods to get hands on and commit to memory stereotyped answers to the examination questions, lacking in comprehensiveness, and being so far as understood by the prospective aspirant to promotion of an entirely superficial nature, merely serving his immediate needs "to get by," then fading from his memory as daylight turns to night.

If we require nothing from a child, that child renders us no service, but rather learns to expect service from us—man is but a grown up child and will render only such service as is required of him, the manner of service performed will depend greatly on firmness of those in authority, who having placed the requirements for qualification at a high standard to insure efficiency insist on requirements being conscientiously complied with.

We know the evil exists and the remedy is obvious, still we defer the operation, because we lack faith in ourselves and our own knowledge of men.

The importance of changing methods of examination was impressed on my mind and the practicability of same positively proven in the year 1890, on one of the largest railroads of the northwest, when the superintendent of motive power became disgusted with the condition of work reports, account of poor writing, poor spelling, wrong names given parts, wrong location given for defects and general incomprehensibility of majority of work reports, as well as forms to be filled out, said: "I will put on a Civil Service examination that will eliminate the possibility of such reports when the men entering service now and in the future are promoted." Knowing that many firemen would be needed, and source from which they were generally secured, I doubted the possibility of securing men with such a rigid examination, and remarked to the superintendent of motive power my candid opinion. He replied that "It is worth trying," and proved the correctness of his opinion through the test, which proved that when educated men learned that brains as well as muscle were required to get a position as locomotive fireman, they sought employment, feeling that the position was elevating, because it required educational qualifications, and those who desired such a position, but lacked the necessary education, went to night school that they might qualify, and today you will find State university graduates and a host of men finished in other high institutions of learning running and firing engines on that railroad. These men realize the need, and appreciate the value of education along the lines necessary to fit them for success in their chosen vocation in life, and will spare no effort that they may be valuable to the system on which they labor, and are held in the highest esteem by the heads of every department, in verification of which a remark made by the general superintendent at the end of the fiscal year 1896 said: "Other roads may have engineers who are starters and stoppers, but my men are artists," proves that education pays.

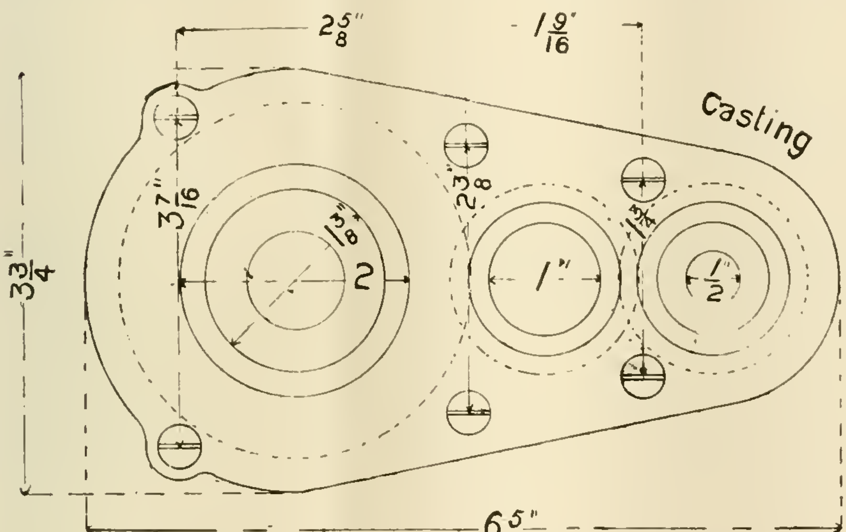
The man who lacks the ambition to study does not aspire to perfection in the performance of his duties; he has no personal pride in his capabilities nor desire to be classed as one of the best, if not the best in the service, goes along through life performing his duties in a slipshod haphazard way, quieting his conscience (if he has one still alive within him) by the assertion, "I will get my information through practical experience," obsessed with the idea that he has builded an impregnable barrier between himself and the more intelligent man who suggests technical education as a foundation for and support to the perfect practical education.

The wheels of progress will ever roll on demanding the man capable of filling the position, irrespective of men with a lethargic mentality which eliminates inquisitiveness and dwarfs the powers of observaton to such an extent that they do not realize the impossibility of gaining through practical experience (in one lifetime) the necessary knowledge pertaining to all the various mechanisms and their defects, any one of which they may be called upon to handle at any time and produce results, nor do they realize the futility of their argument until it is too late to acquire the education so necessary for success.

Of course we realize that where but one branch of education is possible, the practical experience is preferable to the technical education alone, but where perfection is desired it can only be obtained through a combination of the practical with the technical education.

Technical education is not of much value without application, but it is essential to a thorough knowledge, being a guide to the proper practical education, teaching us what to observe and enabling us to benefit by the best practical experience of those who have gone before us following the same vocation in life.

The one who desires to become a successful locomotive engineer will learn



ATTACHMENT OF SPEED REDUCER ON CAR AXLE TURNER.

every part of his engine, and will know the relation each part bears to every other part.

He will learn that most engines have the right main crank pin, one-fourth of a turn in advance of the left main crank pin, and that the eccentrics having the same relative positions to their respective main crank pins must be in the same relative position to each other as are their respective main crank pins to each other.

He will know that with engine placed on top quarter and reverse lever in forward corner, the back admission port on that side of engine is open and with the reverse lever placed in back corner the forward port would be open.

With engine placed on either top or bottom quarter and reverse lever placed in center of quadrant, the valve on that side of engine is on center of its seat, or mid-position.

With engine placed on dead center and reverse lever in either corner of quadrant, the admission port to end of cylinder where piston rests is open the amount of lead, therefore he will deduce the fact that with engine placed on dead center and reverse lever in either corner of rack the valve rests in exactly the same position on its seat, while observation will show him that with the Stephenson valve gear as lever is shifted from one corner to the other the valve will move back and forth a little on account of the changing in radius on which link is being moved, but with the Walschaerts valve gear the valve does not move, because the radius rod is the exact radius of the part of a circle along which the link block is moved.

He should know that if the throttle is closed gradually at each shut-off, there will be fewer broken stay bolts and leaky seams and tubes to bother with than would result from the sudden shut-off, which causes rapid increase in pressure with lack of time for sheets to expand and adjust themselves to resist the strain which will be far above normal for the moment.

Sand should never be dropped on rail while engine is slipping, throttle should be closed and wheels stop slipping before the sand is dropped, and great care should be taken that sand be not dropped when but one sand pipe is operative.

He will bear in mind the fact that in starting and working an injector having used just enough steam to take up all the water at the overflow, best results will obtain, more water be put into boiler and engine will steam better than if more steam were used.

Water used on an overheated bearing will cause crystalization and lead to serious results eventually.

He will not forget that every time his engine "pops" or the safety valves open on account of excessive pressure that steam is being wasted, which means a serious waste of coal and water which may be needed further down the line.

Using the cylinder cocks frequently he will keep all condensation out of cylinders and avoid leaky joints at cylinder heads and broken piston packing rings.

Experience will show him that an engineer and fireman must work in harmony at all times in order to get best results for themselves and their employers.

Theoretically, best results are afforded by working at a short cut-off and with full throttle, but practice will show that there are limitations, and many times best results obtain by working at a little longer cut-off and lighter throttle, and the engine will run faster and go farther for fuel and water; this depends on friction between valve and seat caused by pressure on top of valve.

He will make a study of his engine all the time, and familiarize himself with all her attachments, and endeavor to know the improved attachments before they are adopted on his road.

Success depends on constant study and application, the engineer is paid for what he knows, and he certainly should know how to overcome every difficulty in the best, quickest and safest possible manner with the means afforded him, although he may not have to do the actual work.

He will feel his responsibility to his employer for the results obtained through the manner in which he performs his duty through knowledge of the machine and functions of its various parts.

He will constantly bear in mind the fact that the watchword of the modern railroad is "dispatch," and being a loyal employee, put forth every effort to facilitate the movement of trains and avoid any unnecessary delay or expense. "Time is money," consequently no part of his engine will be disconnected that can be left up and reach a terminal in safety.

There will be no limit in his efforts to serve his employer, for the best interests of the employer and the employee are the same, so by constantly striving to advance his employer's interests he is working for his own good.

It is an undisputed fact that the man who fears he will do more than his stipulated duties, for which he receives remuneration demanded for such labors, never advances beyond that position.

Be progressive and a leader of men, realize that you will either advance and reach promotion through your own efforts or drift into oblivion by lack of interest and inaction.

The position looks for the man capable of filling it today, and to prove capability rigid examinations are an absolute necessity.

Coal Gas.

A pound weight of coal gas is usually taken at 30 cubic feet, says the *English Mechanic*. A cubic foot of coal gas of 16 c. p. has a heat value of 650 units, or 19,500 units per pound, while one pound of paraffin has a heat value of 21,000 units.

Oiling Engine with Train Running.

Through courtesy of our friend Mr. Clement E. Stretton, of Leicester, England, we have a copy of the *London Mail* giving a detailed account of an official inquiry into the cause of an express collision that happened on the Midland Railway. It was occupied chiefly with the evidence of the driver and the fireman of the second express, which ran into the rear of the first, and the following facts as to the cause of the accident were established:—

The driver ran past three signals without observing or looking at them.

His attention was entirely occupied going around his engine and oiling it to overcome lessening of steam due to bad coal.

He frankly admitted his mistake in not looking at the signals.

The firemen, who wished to assume part of the responsibility, during the driver's absence outside the engine did not look for signals because he was attending to his fire.

Neither thought it possible that another train could be standing on the line in advance.

There are some reckless practices on railways in the American Continent, but for a locomotive engineer to ramble about the running board along the engine while a train is in motion is something unheard of. We commend the particulars of this case to the people who supply automatic lubricators to our railroad companies.

A Tunnel Under the English Channel.

The question of constructing a tunnel between England and the main land is again engaging the attention of the British. As far back as 1874, the British Foreign Office expressly approved of the idea, but a few years later the military and strategic aspects came to the front, and the general conclusion was reached that the project was not likely to promote, but might seriously hamper, the best interests of the country when considered from a military point of view. Since that time the scheme has been resolutely opposed by every government in office, and it is only during the past few years that it has been gaining favor, and the interest in it reviving.

Expert engineers have expressed the opinion that unbroken rail communication between England and France may be successfully carried out by a bridge, a tunnel, or a train ferry. It has been estimated that $10,000,000 would establish an efficient ferry service, whereas a tunnel could not be constructed for less than

$40,000,000, and the cost of a bridge would be likely to reach $100,000,000. It is the tunnel, however, that is being most dwelt upon.

Fraudulent Patent Infringement Suits.

Railway companies have been victims of many fraudulent claims for damages on account of infringements of patents. There was a time when certain swindlers made a fat living from looking up patents on railway appliances and threatening to bring suit. The courts were very favorably inclined toward the swindlers in those days and made some amazing decisions in their favor, some of which were ultimately reversed by the Supreme Court of the United States. The most famous of these claims for infringement of patents was known as the Tanner Brake suits, thus described in Sinclair's Development of the Locomotive Engine.

The growth of the train brake has been illuminated by some curious cases of litigation. There were many of them, but that known as the Tanner was the most celebrated, having involved litigation for stupendous sums. The case illustrates on what small foundation claims for infringement of patent rights may be made and sustained by juries and district courts.

Some time in 1846, Batchelder & Thompson of Lowell, Mass., invented a car brake to be operated by the cars crowding against each other, by means of a long rod or bar running under the center of each car. It was a wretched contrivance, and never came into use. They applied for a patent in June, 1847, but owing to various delays, their application was kept pending in the Patent Office till July 1852. In the meantime the Hodge and Stevens brakes had both been patented, the one in 1840 and the other in 1851. In 1846 or '49, Willard J. Nicholls, of Hartford, invented the same thing as that which had been known as the Tanner Brake. He put it into use, but never applied for a patent. In 1848, one Turner obtained a patent for a double brake bearing some resemblance both to the Batchelder & Thompson and the Nicholls. It had also a center lever, but not arranged like the Nicholls.

Now commences the most curious part of this story. In 1850 or '51, Henry Tanner, of Buffalo, bought the Turner patent above mentioned, and went about the country attempting to bring it into use. In this he met with little or no success, but in other respects he was more fortunate. In the course of his travels he came across the Nicholls brake, and, finding it far superior to the Turner, he gave up the Turner and adopted the Nicholls in its place. As there was no patent, however, on the Nicholls brake and as a patent of some sort was necessary, he determined to reissue the Turner patent with a claim that would include the invention of Nicholls. But on going to Washington for that purpose, he was made aware of the pending application of Batchelder & Thompson. As he had already shifted his ground from Turner and Nicholls, so he now resolved to shift again from Nicholls. He bought out Batchelder & Thompson, cancelled their model, specifications and drawings and substituted in their place a new set of papers to suit the Nicholls; and on July 6, 1852, the patent was issued, not for the bumper brake of Batchelder & Thompson, but for the hand brake of Willard J. Nicholls, since known as the Tanner brake. As a justification for all this it has since been alleged that Batchelder & Thompson also invented this same brake, and some months earlier than Nicholls; but, while this may be true, it must be admitted to be extremely improbable.

In 1853, Tanner began a suit against the Erie road for infringing his patent by using the Hodge & Stevens brakes. The jury found in his favor and awarded him $439 as damages and costs. A similar suit against the Hudson River road was settled by the payment of $1,000.

In 1855, Thomas Sayles, of Lansingburg, N. Y., having previously become owner of the patent, filed a bill against the Erie road for an injunction, which was settled together with the suit at law for $2,300.

As a natural result of this litigation, a large number of roads took licenses under the Tanner patent, paying therefor at the rate of $6.00 per mile. The greater number, however, still holding out, in 1858 Sayles filed a bill in Pennsylvania against the Philadelphia, Wilmington & Baltimore road, but after the evidence was all in, he for some reason concluded to dismiss that suit and to commence again in another jurisdiction.

He accordingly filed his bill in Illinois against the Chicago & Northwestern road, December 28, 1861; the case was heard before Judge Drummond, and a decree entered in favor of complainant in February, 1866, with the usual order of reference to the master to take an account. While this was pending the defendants obtained evidence of the use of a double brake like the Tanner on the Camden & Amboy road in 1843, and on application to the court, leave was given them to take additional proofs, when the matter was again argued, and again decided in favor of complainant in July, 1871.

The accounting before the master, which was next in order, occupied a long time, and the loss of all the papers by fire caused additional delay; but a final decree, as was supposed, was at last reached in December, 1873. By this decree the defendants were to pay for five years' infringement on a small part of their road, $63,638.40, being at the rate of about $450 per car per year, two-thirds for the saving in brakemen, and one-third for the saving in wheels. If all the roads in the country had paid at the same rate, the total amount for the 21 years of the patent would have been about $90,000,000.

A petition having been filed, to set aside this decree, also on the ground of newly discovered evidence, the matter was again argued at great length, and at last finally decided in September, 1875. By this decision the court affirmed all its previous findings, but at the same time struck off some $16,900 from the decree, without assigning any reason, but undoubtedly on the ground that the damages were excessive. The decree as finally entered was still sufficiently onerous, the savings (!) now being about $350 per car per year, and the total value of the patent $70,000,000.

From this decree defendants appealed to the Supreme Court, where the decree was reversed in November, 1878, and the cause remanded, with directions to dismiss the bill on the ground of non-infringement. This released absolutely not only the defendant in that suit, but all others who had used the Stevens brake, comprising a large proportion of the roads, especially at the West. The opinion of the court further indicated pretty clearly that the Hodge brake, when its turn came, would also be held no infringement, and that the Tanner patent itself would be held invalid on account of the change made in the application as above stated. But, as neither of these points was decided, it left Sayles at liberty to continue the litigation. He had already, in 1877, brought some 200 new suits, 33 of which were against members of the Western Railroad Association, 30 in equity and three at law.

The question came at last before the Supreme Court in Root, Executor, etc., vs. the Lake Shore & Michigan Southern road, and there it was finally decided in January that a suit for infringement, as a general rule, cannot be maintained in equity after the expiration of the patent.

After obtaining his decree against the Chicago & Northwestern Railway Company, Sayles offered to settle with the railroads for $15,000,000 and passes. He gradually reduced his demand to $3,000,000, and after that decree had been reversed in the Supreme Court, he came down to $350,000.

He was now dead and his executor was willing to settle for $500, which, after some hesitation, it was thought best to pay, and thus ended this litigation, so far Sayles' interest was concerned.

Coating for Cast-Iron Patterns.

A coating that will resist any corrosion on cast-iron patterns may be applied as follows: Coat the surface with boiled linseed oil, using a brush, then heat the casting sufficiently to char the oil. The pores of the metal will thus be filled, and no moisture can enter.

Pacific Type Locomotive for the Baltimore & Ohio

The Baldwin Locomotive Works has recently constructed 30 Pacific type locomotives for the Baltimore & Ohio Railroad. They are admirably adapted for express passenger traffic on divisions having moderate grades. The tractive force available is 34,200 pounds.

The design of the locomotives has been worked out with unusual care. The materials are of the best. Several improvements are apparent especially in the construction of the boiler, which is of the straight top type, equipped with superheater and brick arch. With improved methods of flanging, the domes are made with little or no thinning of the metal. The main dome which is of pressed steel is 33 inches in diameter and 21 inches in height. The auxiliary dome is placed back of the main dome on the same boiler ring. It is mounted over a 16-inch opening in the shell, so that the boiler can be entered for inspection purposes without dismantling the fittings of the main dome.

A complete installation of flexible bolts is used in the side of the firebox, and also in the throat and back-head, while the front end of the crown is supported on four transverse rows of flexible bolts. The rocking grates are in four sections, and the ash-pan has three hoppers, with sliding bottoms. An air fire-box is used. The tubes have ⅞-inch bridges, and the large tubes ½-inch bridges.

The valve motion is of the Walschaerts type, and the gears are controlled by the Ragonnet power reverse mechanism. The cylinders are bushed and are fitted with vacuum relief valves and with by-pass valves of the Sheedy pattern. The engine frames are 5 inches wide and are cast in one piece with a single front rail which has a depth of 10 inches at the cylinder fit. The main driving pedestals are braced by a steel casting which extends the full depth of the frame.

The rear truck is of the improved Hodges type. The boxes are of cast steel, and are made with side extension for bolting them to the truck frames, so that they really constitute part of the latter. The frame is composed entirely of steel castings. The equalizers connecting the rear driving springs with the truck springs are placed on an angle, and receive their load directly from the truck spring links, without the intervention of crossbeams. The spring links are designed to swing in planes parallel to a tangent to the arc in which the truck swings when the locomotive is curving: this arc being struck through the center of the spring seat on the truck box. The spring links connected with the equallizers, are held in alignment by suitable guides; while those at the back of the truck are pinned directly to cast-steel brackets bolted to the engine frames. The centering spring is placed in a horizontal position under the foot plate, and is acted upon by thrust bars pinned to the rear transverse section of the truck frame.

Brakes are applied to the rear truck wheels and provision has been made to apply brakes to the front wheels if at any time it should be deemed desirable. A speed recorder is driven from the right rear truck axle.

The tank is of the water-bottom type and is designed for a water scoop. A coal pusher is applied, and the fuel space is closed in front by steel gates. The tender truck wheels, as well as the leading engine truck wheels, are of solid rolled steel.

The engines are mostly in service on the Philadelphia division, and in the fast and heavy service at that point, they are proving to be fully capable of more than meeting all expectations.

The following are the general dimensions:

Gauge—4 ft. 8½ ins.; cylinders, 24 x 28 ins.; valves, piston, 14 in. diameter.

Boiler—Type, straight; diameter, 72 in.; thickness of sheets, 11/16, 23/32 and ¾ ins.; working pressure, 190 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 108⅛ ins.; width, 75¼ ins.; depth, front, 74 ins.; depth, back, 59½ ins.; thickness of sheets, sides, ⅜ ins.; thickness of sheets, back, ⅜ ins.; thickness of sheets, crown, ⅜ ins.; thickness of sheets, tube, ½ in.

Water Space—Front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

Tubes—Material, steel; diameter, 5½ & 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; 2¼ ins., 0.125 in.; number, 5½ ins., 25; 2¼ ins., 140; length, 20 ft. 0 ins.

Heating Surface—Fire box, 185 sq. ft.; tubes, 2359 sq. ft.; firebrick tubes, 23 sq. ft.; total, 2567 sq. ft.; grate area, 56.5 sq. ft.

Driving Wheels—Diameter, outside, 76 ins.; diameter, center, 68 ins.; journals, main, 10½ x 13 ins.; journals, others, 9½ x 13 ins.

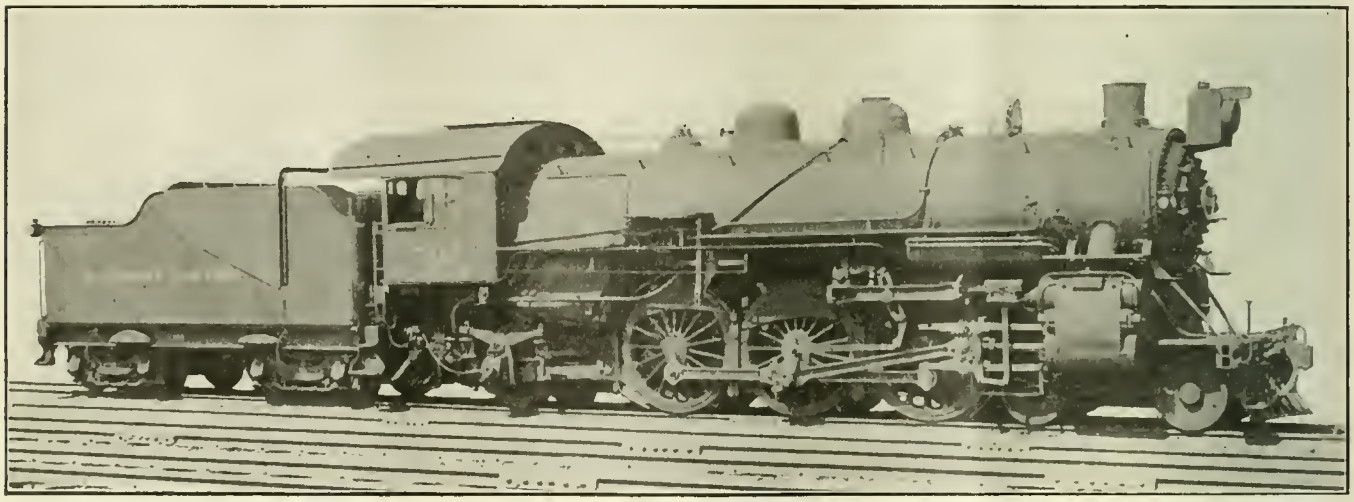
Engine Truck Wheels—Diameter, front, 37 ins.; journals, 6½ x 12 ins.; diameter, back, 52 ins.; journals, 8 x 14 ins.

Wheel Base—Driving, 13 ft. 2 ins.; rigid, 13 ft. 2 ins.; total engine, 34 ft. 3½ ins.; total engine and tender, 60 ft. 8¾ ins.

Weight—On driving wheels, 159,200 lbs.; on truck, front, 49,300 lbs.; on truck, back, 40,100 lbs.; total engine, 248,600 lbs.; total engine and tender, 413,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 36 ins.; journals, 6 x 11 ins.; tank capacity, 7,000 gals.; Fuel capacity, 16 tons.

Superheating surface, 587 sq. ft.



PACIFIC 4-6-2 LOCOMOTIVE FOR THE BALTIMORE & OHIO RAILROAD.
F. H. Clark, Gen. Supt. of Motive Power. Baldwin Locomotive Works, Builders.

Catechism of Railroad Operation

Announcement.

We are pleased to be able to announce that we have completed arrangements for the publication of a new series of Questions and Answers embracing the important field of railroad operations insofar as the mechanical appliances used in their operations are concerned. The examinations that are being held by the railroad officials, especially those affecting engine men and firemen, are year by year becoming more complex and exacting. This was to be expected, as the constant changes and improvements that are being made on the locomotive and its attachments, render new additions to the examinations a necessity. We are prepared to meet this necessity, and to this end we have collected samples of the examination books that are being used on the leading railroads in America and guarantee a correct answer to every question formulated by the railroad officials in the various forms in which the series of examinations for promotion appear at the present time.

This work is not new to us. It has been our constant aim to meet the great and growing demand among the younger railroad men for a reliable guide in matters affecting their knowledge of the calling in which they are engaged, and the demand for a continuation of the work grows with the growing years, and it is pleasant to know that our efforts have met with a degree of appreciation that is not approached by the work of any other periodical published. Indeed, our success has brought to us its consequent difficulties. We are constantly being called upon to prepare a distinctive and separate set of answers to suit the questions presented by the officials of some particular railroad. This would be an easy task if the railroad officials agreed among themselves as to some particular form or series of questions, but as long as the system of examinations is varied and irregular in the presentation of the subjects involved, it would be idle to prepare a complete set of answers that would suit the questions used on some particular railroad, and thereby give an advantage to the employees engaged on that section, and leave all others to make such selections from the publication as might suit their immediate needs.

Undoubtedly it is better as it is, because a mere learning by rote of an answer to a question is not education in the higher and proper sense. A complete understanding of the subjects on which the candidates for promotion are being examined should be the real aim of the thoughtful student, and as our new series of questions and answers will embrace the entire field of operations to which we have referred it is better that something should be left to the earnest seeker after knowledge that he should exercise some diligence in finding out where the special information that he requires is to be found.

As on former efforts to meet the requirements of the situation we have secured the assistance of some of the leading experts in America—men who are actually engaged in railroad work, and who in their brief leisure hours have found time to note the result of their observations to the end that others may share in the larger vision of the operation of mechanical appliances that only comes through study superadded by experience, and which eludes and ever will elude the mere technical theorist as well as those who are content with the mere mechanical performance of a certain amount of drudgery for a certain number of hours a day.

In a publication like Railway and Locomotive Engineering with a constantly increasing demand upon its pages for descriptions and illustrations of the improved products of the railway supply trade, it is not possible to present other than a limited portion of the educational features of our work in each issue. The course which experience has shown to be the best will be maintained, and it will be to the benefit of the railroad men to take up the new series of questions and answers from the beginning and continue to follow them from month to month. The new series will begin in the November issue, and will be continued during the winter months. Illustrations will be added where they are deemed necessary, and, as we have already stated, the particular merit of the series of questions and answers which are about to begin will lie in the fact that they will embrace not only all that is necessary to be known to pass the examination courses used by the leading railroads in America, but will also furnish details of the more important mechanical appliances, the careful perusal and study of which cannot fail to place the student in the front rank of the railway employees of our time.

In conclusion, it may be added that the great success which has attended our efforts in this field of educational work in the past is the best guarantee that the same high standard of authority will be maintained in the future. The workers in this field embrace the names of many of the most eminent railroad men in America. Nearly all of them have risen to distinction. From the very beginning, twenty-five years ago, the work has been supervised by Angus Sinclair, the only railroad man in America on whom the title of Doctor of Engineering has been conferred, and who bids fair to continue for many years in the high calling he has chosen. In this work he has been aided by such men as John A. Hill, now president of a great publishing company engaged in other engineering fields. Fred. A. Colvin, editor of the *American Machinist*, C. B. Conger, author of standard works on the Air Brake, Fred. M. Nellis, secretary of the American Air Brake Association, F. P. Roesch, president of the Traveling Engineers' Association, James Kennedy, managing editor of Railway and Locomotive Engineering, and other versatile and accomplished engineers and writers. The co-workers and successors of these men, eminent in their calling, are being constantly looked for and their services engaged from time to time to the end that the high standard set for such work may be maintained and the requirements of present-day railroad work made clear to the younger men who naturally look to their elders for instruction.

In relation to this subject it will be noted that we maintain a department where special questions and answers appear on any subject that may suggest itself to our readers. Only a limited number of such questions as come to us appear in print. Many of them are elemental and others are abstruse and hence of little value to the general reader. Those that are calculated to be of interest to our readers will always find a place in our columns. Those that are distinctively of individual interest will be replied to by letter, as promptly as possible, and in the answers to such questions it will continue to be our aim to place the facts as we see them before our readers in such language and characters as will not require interpretation. While the things that we know may be few in comparison to what we do not know, we will never conceal our doubts with a mantle of unintelligent jargon.

Questions Answered

SETTING UP WEDGES.

L. M., East Tawas, Mich., asks: In setting up wedges is it necessary to place the engine in any particular position or to move it from place during the operation? A.—In setting up wedges it is necessary that the engine should be heated and under steam pressure, because the parts of the frame that are near the firebox become heated to some extent and slightly expand. The crank pins should be on the top center on the side where the wedges are being set up. A block may be placed on the rail back of the main driving wheel and the engine moved back against it, or the wheel may be pinched forward with a pinch bar, the object being to jam the driving box against the shoes so that any lost motion that there may be between the driving box and wedges will be at the back of the box, so that the wedges will move up freely. Set the wedges up moderately with a 12-inch monkey wrench and tighten the jam nuts with a large wrench. The reason the crank pins should be on the top, on the side that the wedges are being adjusted, is because if the pins were at or near the center and the side rods were too long or too short they would force one of the driving boxes against the wedge instead of the shoe, and if the crank pins were below the centers when the wheel was pinched forward the side rod would have a tendency to draw back on the crank pin and would, therefore, draw the box back against the wedge, while if the crank pins were on the top quarter the tendency would be to force all the boxes on that side against the shoes. It would be well to slack all the rod keys before setting up the wedges, if the rods are keyed, and tram the wheel centers when the job is finished. When the wedge is tightly screwed up a good plan is to scribe a line on the frame at the top of the wedge, then draw down the wedge about ⅛ of an inch, and jam the nuts on the wedge bolt. It must be observed that if there is lost motion on the head of the wedge bolt, the bolt should be so adjusted that the wedge cannot slide down an added distance on account of the lost motion.

BOILER PRESSURE.

S. J. H., Meadville, Pa., writes: Please state whether or not in a locomotive boiler with 200 pounds steam pressure and three gauges of water the pressure is greater on the mud ring and in the legs than it is on that portion of the boiler above the water line. ANSWER—The pressure in the lower part of the boiler is slightly greater than it is on that portion exposed to steam only above the water line, the exact difference being the weight of a column of water one inch square and of a length equal to the distance from the mud ring to the surface of the water in the boiler. Under 200 pounds pressure of steam, water has a temperature 381.6 degrees, Fahrenheit, and at this temperature, weighs .0316 of a pound per cubic inch. Suppose the height of the water to be 55 inches, then the pressure per square inch upon the mud ring would be 55 x .0316 added to 200 or 201.74 pounds. This difference being so small, it is not customary to take it into consideration either in boiler design or other questions pertaining to boiler pressure, and the usual answer given to questions of this kind is that the pressure is the same.

WEAR OF CYLINDERS.

R. I. L., Omaha, Neb., writes: In boring out a cylinder here it was found that they were worn more on the top than on the bottom. Can you tell why this was so? ANSWER—It is very unusual that both cylinders should have shown the wear to be greater on the top. The wear should take place more on the bottom of the cylinder than on the top, with the engine generally running forward. The wear on the bottom is due to the weight of the piston and rod, and the only reason why a cylinder wears more on the top than on the bottom is that the guide bars have been lined up too low. Sometimes an apparent variation in the wear of cylinders is shown in boring out on account of the variation of the hardness of the metal, the thinner parts of the cylinder being harder than the thicker parts, on account of the fact that the thin portions had cooled more rapidly. This variation rarely extends to the outer faces of the cylinder. The softer parts of the cylinder are worn deeper than the harder parts.

WHEELS SLIPPING.

B. J. L., Cloverport, Ky., writes: One of our ten-wheel engines that is running a passenger service has developed a peculiarity that is a mystery to us. When the engineer shuts of the throttle to make a stop, the driving wheels begin to slip on the rail. What could make an engine's drivers slip with the steam shut off? ANSWER. This is occasioned by what may be called the reverse action of the engines. That is, instead of the piston driving the cranks, it is the cranks that drive the piston, and as the cranks are only 90 degrees apart the driving wheels are submitted to irregular shocks, the disturbing force of which induces slipping. It may be added that there are varying opinions in regard to slipping while drifting, some experienced engineers claiming that slipping is a certain sign of defective quartering of wheels out of tram having the effect of causing a strain in the rods in passing certain points during the revolution and that when the point is passed a sudden shock is imparted to the wheel that induces slipping. Irregular or unevenly distributed weight on the drivers is also claimed by some as causing slipping. The application of sand or a light application of the air brake will act temporarily, but the real cause and remedy is largely a matter of experiment.

BALANCING VALVES.

A. S. R. Buffalo, N. Y., writes: In an answer to a question regarding the balancing of valves your explanation was excellent as far as it went but it did not state the percentage of balancing. Should the balanced area be measured from the outside of the strip? In the case of the Richardson valve, what percentage of balance are these valves supposed to have? ANSWER. The balanced area should be measured from the outside edge of the strips. The Richardson slide valve is generally balanced about 55 per cent. of the area of the valve face.

MAIN DRIVERS.

W. P. Melrose, Minn., writes: We have a class of engines where the main rod is connected to the third driving wheel, while the eccentrics and valve gear are on the second driving axle. Which is the main pair of wheels? ANSWER. The main driving wheels are the ones to which the connecting rod is attached. In this case the third main axle is the one upon which the pistons drive.

SIZE OF RESERVOIR.

J. H., Ft. Wayne, Ind., writes: What is the cubic inch capacity of the auxiliary reservoir of a 10-inch freight car brake and how is it determined.

A.—About 2,440 cubic inches, while in passenger service the 12 × 27 replaces the 12 × 33 for 10-inch brake cylinders, the capacity of the 12 × 27 is 2,450 cubic inches.

The engineers of the air brake manufacture used a very simple method of reasoning and deduction to determine the size of reservoir to be used with the different sizes and installation of cylinders. Knowing the brake pipe pressure employed, and length of brake cylinder piston travel desired, the capacity of the brake cylinder in cubic inches at the proper piston travel is calculated.

Then according to present practice. 50 lbs. brake cylinder pressure is desired to produce full service braking power from a standard 70 lbs. auxiliary reservoir pressure.

It is obvious that with the brake piston in release position, its atmospheric pressure, with the piston out, must come from the auxiliary reservoir, and its capacity must be such as to produce a 50-lb. equalization with a 20-lb. drop in pressure,

hence the absolute equalization pressure obtained (50 + 14.7) divided by the drop in pressure (20 lbs.) multiplied by the brake cylinder capacity in cubic inches equals the cubic inches capacity necessary in the auxiliary reservoir, or if—

A = Absolute equalization pressure,
R = Reduction in pressure,
V = Volume of brake cylinder,
P = Volume of auxiliary reservoir,

$$P = \frac{A}{R} \times V$$

$$\text{or } \frac{65}{20} = 3\frac{1}{4} \times V = P$$

If the brake cylinder volume were 10 × 8 (628 cu. ins.) or 8 × 8 (402 cu. ins.) constant and no losses due to leakage, reduction in temperature, movement of piston and triple valve a smaller reservoir would be used, but as the clearance volumes in triple valve and cylinder bring the total to about 700 cu. ins. and 460 cu. ins. respectively, a reservoir of 3½ times the cylinder volume is used to compensate for the losses, hence 700 × 3½ = 2,450 reservoir capacity for the 10-inch cylinder and 460 × 3½ = 1,610 the auxiliary volume of the 8-inch equipment.

BRAKE APPLIES.

H. R. K., Indianapolis, Ind., writes: What causes the No. 6 E. T. brake to apply when the brake valve handle is in release position? No leakage can be found anywhere in the system.

A.—It is caused by the equalizing position of the distributing valve being more sensitive to respond to the lowering of pressure in the system than the excess pressure head of the pump governor to permit the pump to maintain the pressure at a constant figure. Assuming that there is no leakage into the application cylinder or its pipe connections when the valve handle is in release position, the release pipe is closed, and when the governor stops, the pump air pressure falls through the escape of air from the waning port via the feed valve, and from the main reservoir through the relief port in the governor, and is again restored as soon as the governor allows the pump to start.

This variation in pressure evidently affects the distributing valve in that it permits alternate movements between release and application positions of the equalizing valve, and after a few movements sufficient pressure to apply the brake is built up in the application cylinder.

BRAKE "CREEPS" ON.

H. R. K., Indianapolis, Ind., writes: You state that brake pipe leakage causes the No. 6 E. T. brake to apply if the feed valve does not promptly open up to supply the leakage. What is wrong if the brake occasionally creeps on with the handles in running position but will not apply when the automatic valve is in lap position?

A.—While the amount of brake pipe leakage necessary to operate the brake depends upon the condition of the distributing valve, it is evident that the action you mention is the result of leakage in the feed valve pipe or the excess pressure governor pipe; thus the condition of the feed valve might be such as to permit the leakage to apply the brake while the valve handles are in running position, but in lap position of the automatic valve the feed valve and excess pressure pipes are separated from the brake pipe, therefore the leakage cannot at this time affect the distributing valve. Keeping this sluggish condition of the feed valve in mind, you can also reason out how a leaky rotary valve in the automatic brake valve, leaking to the atmosphere in running position and into the brake pipe when in lap position, could cause the action you describe.

CARDINAL PRINCIPLES.

A correspondent states that they have some very profound thinkers in their shop and the other noon time he heard two of them disputing about cardinal principles. He could not make out what the subject was about, but I know that it began by one of the men saying that it was not wrong for a mechanic to soldier so long as the boss did not detect him. The other man said that honest workmen hold to cardinal principles and then the dispute waxed hot. Please let a seeker after knowledge know what these principles amount to. A. The cardinal principles are sobriety, truth, justice, morality and do unto others as you desire that they do unto you.

A Stickler for "Engineer."

Under the above caption the New York *Globe* recently published the following letter:

Editor of *The Globe*, Sir—In commenting in tonight's *Globe* upon a certain railroad matter you repeatedly refer to the engine drivers of the New York, New Haven and Hartford Railroad. Now, I respectfully protest that the railroad vocabulary of the United States does not contain the words "engine-driver." The men who run locomotives in America are called enginemen or engineers, popular practice giving them the latter title. To call these workmen out of their recognized appellation is a gratuitous slur cast upon a reputable class of men.

The writer of the article where the offensive term was used no doubt tried to imitate English practice, you know, but it does not go down well with Americans. The man who runs a locomotive in the British Isles is called an engine-driver, the term having originated when the engine runner was classed on the same level as driver of carts or hacks. Americans have from the inception of railroads recognized the skill and judgment involved in the management of a locomotive engine, and it became the universal practice to call the man performing that important duty an engineer, a title to which he is honestly entitled.

Snobbish editorial writers may strive to have the American public adopt the term engine-driver because it sounds so English, but the attempt has been made too late. The people at large call the engine runner the engineer; it has become a part of our language and cannot be changed.

ANGUS SINCLAIR,
Editor LOCOMOTIVE ENGINEERING.

New York, August 22.

[*The Globe* had no intention of casting a slur by the use of the phrase complained of. Nor was it aware that it "sounds English." For newspaper purpose engineer is shorter, therefore preferable.—Editor.]

Mysteries of Steel.

Nearly every mechanic knows that if you heat steel and permit it to cool slowly the metal becomes soft; but if you quench it suddenly in cold water it becomes very hard and can be ground into cutting tools, swords and knives. These are well known facts and most people regard them of little consequence, but an investigator of natural phenomena wishes to know the real cause of the difference. Science has tried hard to find out why steel behaves as it does under the different treatment described, but no rational explanation has been given. Have any of our steel workers been able to solve this mystery?

Peculiarity of Japanese Steel.

The Japanese are very skillful in the working of steel and there are peculiarities in their product not possessed by steel worked in other countries. For instance: If you heat an old Japanese sword, which for centuries has held its edge intact, even when cutting off human limbs and performing other arduous work, to the temperature of boiling water, it gradually softens and loses its cutting edge. No other steel will be seriously affected by being raised to temperature slightly above 200 degrees. That same Japanese steel will hold its temper indefinitely, so long as it is kept at a moderately low temperature.

"Some of the best razor strops in the world are made out of old belting," said Daniel M. Hendricks, a miller of Minneapolis. "A good razor strop is worth $4 or $5, and its value lies in the fact that the grain of the leather must not run one way.

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Steam Making and Using.

In connection with steam raising, enginemen frequently hear the term "atmospheric pressure" used. That means the pressure of the air at sea-level and is equal to 14.7 pounds to the square inch. The pressure shown by a steam gauge is the pressure above the atmosphere. Sometimes the expression absolute pressure is used, which means the ordinary gauge pressure plus the atmospheric pressure. As heat is applied to a steam boiler and steam proceeds to form, the temperature of the steam rises with the pressure. The water begins to boil at 212 degrees, Fahrenheit, and the temperature rises steadily as the pressure increases. When the pressure reaches 160 pounds the temperature of the steam is 370.5 degrees. The steam table in any book that treats of steam will furnish these figures; but it is wise for young enginemen to keep a few such figures in their memory.

The work done by a locomotive forms the process of converting heat into work-motion against resistance. This heat appears in tangible form in the fire box; a portion of it is transferred to the water in the boiler, some of it passes away through the smoke stack and some of it warms the surrounding air. Of the heat that is utilized in making steam some by radiation from the cylinders, some is lost by condensation in the cylinders and steam chest, and some is transformed into the work of moving the pistons against the resistance of the motion of wheels. But the greater part of it passes away from the cylinders with the exhaust steam into the atmosphere. It is not possible in the light of present knowledge to realize as effort on the driving wheels more than a small per centage of the heat generated in the fire-box.

The process of steam generation is having the water in the boiler come in contact with the hot sheets and flues, known as the heating surfaces. When this contact takes place bubbles of steam are f med which ascend through the water to the surface, being then ready to pass into the dry pipe, thence to the cylinder where the throttle valve is opened. The ability of the bubble to form depends upon the strength it has derived from the heat imparted to it. The greater the pressure on the surface of the water, the greater is the difficulty for the bubble to form with sufficient strength to force its way through the water. From this it will be understood how it is harder to make steam at a high than at a low pressure; also why the boiling point rises as the steam pressure increases.

The heat of combustion of one pound of good coal is 14,500 heat units, each being equivalent to 778 units of work, one heat unit being the heat required to raise the temperature of one pound of water at its greatest density, 1 degree, Fahrenheit. If it were possible to convert the whole heat energy of one pound of coal into mechanical work, the result would be astounding, but huge losses intervene from the causes already mentioned. The problem would be to raise one pound, $14,000 \times 778 = 11,281,000$ feet or a little over 2,136 miles. If this pound weight was raised to the height shown, in one hour we could find out the popular unit of work represented. One horse power is the equivalent of 33,000 pounds raised one foot high in one minute or $33,000 \times 60 = 1,980,000$ feet in an hour, that is 1,980,000 foot pounds. Then $11,281,000 \div 1,980,000 = 5.7$ horsepower. It is worth time mentioning these facts to show the difference between the theoretical and the practical performances. Few locomotives do their work on less than 5 pounds of coal per horsepower per hour, and most of them consume double that quantity. There are great possibilities of saving in reducing the volume of steam required to keep a locomotive doing its daily work.

Steam in the presence of water is always at what is called the dew point or the temperature at which it is ready to fall back into water and is known as saturated steam. That is the condition of steam as it passes from the boiler to the cylinders. When the steam reaches the cylinders, which are colder than the steam, the steam parts with some of its heat to the cylinder metal, a portion of the steam is condensed and deposited on the metallic surface, and more steam from the boiler enters the cylinders to take its place, while the temperature of the cylinder rises to that of the steam in contact with it. If the steam be supplied to the cylinders at the initial pressure and temperature throughout the whole stroke, and the exhaust port be then opened, the steam will escape into the air and the pressure in the cylinders will fall nearly to that of the atmosphere.

But the water of condensation, being in contact with the metallic walls of the cylinder at the temperature of the initial steam, will evaporate immediately the pressure is reduced by the opening of the exhaust, and be reconverted into steam at the expense of the heat in the metal of the cylinders, thereby cooling them to the temperature of the steam during exhaust. The steam thus re-evaporated during the exhaust, not only absorbs heat which will have to be made up again from the entering steam during the next stroke, but it passes away to the air without doing any useful work, in fact it increases the back pressure.

This process of steam condensation and re-evaporation goes on all the time in steam engine cylinders and is responsible for enormous heat losses. Early in the railway era Daniel Kinnear Clark, a famous Scotch mechanical engineer, made most exhaustive experiments to ascertain the heat loss due to cylinder condensation, and he made it out to be not less than 25 per cent. of the steam generated in a locomotive boiler. Chief Engineer Sherwood, of the United States Navy, devoted much time and labor to ascertaining the losses from cylinder condensation in marine boilers, and his conclusions were similar to those of Clark, but he held that the loss from cylinder condensation was often 50 per cent.

Many experiments were made with appliances designed to prevent cylinder condensation, but most of them operated to keep up the heat of the cylinders. Experiments of this character were conducted by James Watt and many other engine designers who believed that steam jacketing of the cylinders would remedy the evil. George Richardson, inventor of the pop safety valve, and Frank F. Hemenway, author of "Indicator Practice," made a most exhaustive series of

experiments with hot air as a preventative of cylinder condensation, but those and every other attempt to heat the cylinders sufficiently to prevent condensation failed. Hemenway told the writer that they heated cylinders almost red hot and got the steam condensed in them.

Watt believed that keeping the cylinder as hot as the steam entering it would prevent cylinder condensation. That theory was widely circulated and many of his friends tried the remedy, but he was mistaken, and many expensive attempts were made in reducing his theories to practice.

About fifty years ago a new theory was introduced as a remedy for cylinder condensation which was, that the steam admitted to the cylinders should have in itself sufficient surplus of heat to prevent condensation on touching the cylinder metal. That system began slowly to find favor with marine engine and stationary engine users, and the steam saving that resulted convinced the most skeptical that prevention of cylinder condensation was a very profitable operation. Then of course locomotive men began to patronize the improvement, but for a long time very little success was achieved. A locomotive boiler is an awkward vessel to provide with extra heat-producing equipment, so the first inventor who attempted to superheat the steam for locomotives tried heating appliances designed to utilize the hot gases on their way to the atmosphere, after having passed through the flues. That did not prove satisfactory for two reasons. The apparatus in the smoke-box caused inconvenience to workmen and obstructed the natural flow of gases; and there was not sufficient heat to superheat the steam to the required temperature.

One of the most intelligent experimenters with superheated steam for locomotives was Dr. Wilhelm Schmidt, who carried out his tests on the Prussian State Railways. He submitted the smoke-box superheater to most exhaustive tests, but after a few years' experience abandoned the smoke-box arrangement for a fire-tube superheater which was brought out about seventeen years ago and has proved so satisfactory that it is rapidly becoming the standard for locomotive use.

There are several modifications of the Schmidt fire-tube superheater, but that used most is called type A top header, which consists of groups of four pipes about 1½-inch outside diameter located inside of some 5⅜ or 5½-inch outside diameter flues, placed in the upper portion of the boiler, having their back end swaged down to 4½ inches outside diameter to secure better circulation of water next to the firebox tube sheet.

We advise all our readers connected with locomotive operation to make themselves familiar with details of this superheater, because the indications are that within the next ten years all new, or nearly new locomotives, will be equipped with superheaters, the best economizer of heat that has ever been applied to a locomotive.

The Freight Car Door.

From time immemorial or at least as far back as railroad rolling stock has been a subject of study, the box car door has been the least efficient member of the railway equipment family. The necessity for loading goods into a car and taking them out again, called for large openings on each side which was closed by something called doors, but too often they were doors more in name than in reality. They closed the openings roughly, but did not fit snug enough to exclude wind and weather. The attempts made at various times to improve the car door have done little to overcome the weak points, for the idea of cheapness has prevented the making of substantial parts that would sustain the varying shocks and strains to which a freight car door is constantly subjected, by shocks due to rough track and the awful strains of wind and weather.

The inferior car door causes direct and indirect losses to railroad companies that in many instances seriously interfere with the net earnings. People who have subjected the shortcomings of car doors to the test of exact statistics, allege that a car door falls off or is destroyed in a way to put the car out of service every thirty minutes. On twenty miles of track of one large terminal 250 car doors fell off in 30 days. The loss from doors falling off is merely a small part of the expense incurred from the use of inferior car doors, for injury to freight counts up into huge sums. Like all other cheap articles, the car door on which two or three dollars has been saved swells up the cost of repairs enormously. Carrying grain in cars equipped with inferior doors is frequently an expensive operation to the carriers. One railroad company paid out in one year $200,000 for grain lost in transit, the greater part of the loss being due to defective car doors. Any one who walks frequently through great car yards is constantly finding a trail of grain that has escaped from cars. When the origin of such an expensive trail is followed, it nearly always leads to a defective car door. Grain shippers have made the statement that losses for grain in transit approximates annually $1,700,000, at which we are not surprised considering the scattering of grain over almost every railroad track in the country.

But grain spread over every right of way, represents only a small part of the loss caused by defective doors that can be opened with a stone by any thief wishful to possess himself of part of the car's contents. The crying need of today is the application of car doors made so substantially as to defy weather and thieves. All sorts of car locks have been invented, and invention in this line is still active, but every car lock and seal soon proves inefficient because the door lacks the necessary strength to substantially keep the openings tight from weather and pilferers.

There is a certain remedy for these notorious car door troubles if it is honestly sought for. We recently examined the Rumsey car door, which in our judgment will overcome all defects recognized in the common freight car door. Mechanical science fails to meet ordinary expectations if it cannot design a car door as strong as the body of the car. The Rumsey door transmits shocks to the posts through interlocking functions, which in turn transmit by the anchorages to lower and upper sills, to the superstructure. A detailed description is not necessary, for any builder of freight cars can obtain convincing evidence concerning the perfection of this car door by applying to the Rumsey Car Door Company, of Chicago. We are departing from our usual practice by so highly commending a patented article, but the case deserves special treatment.

Automatic Stop Signals.

The recent accident on the New York, New Haven & Hartford Railroad has stirred up the public to demand the introduction of devices which will stop trains automatically when the engineer fails to perceive a danger signal. The answer given by the railroad companies to this demand is that no automatic device has been sufficiently perfected to give reliable protection. This is the best excuse that can be offered, but we are under the impression that several systems of automatic stop signals are as well developed as some other train appliances were when they were first applied. In a recent report on a rear-end collision, the Interstate Commerce Commission remarked:

"A consideration of accidents of this character which have occurred within the past two years leads inevitably to the conclusion that even the most complete and modern system of fixed signals is not adequate under all circumstances to insure the safe operation of trains. This accident again calls attention to the necessity for some form of automatic train-stopping device."

The attitude of the public in regard to automatic stop signals was well described in an editorial in the *Globe*, which reads:

"This is the vital point of the whole matter. If there had been automatic train-stopping devices on the New Haven road,

the wrecks at North Haven and Stamford could not have occurred. Nor the one on the Long Island Railroad yesterday at Bridgehampton. And it seems pertinent once more to ask why the railroads do not display more interest in the question of automatic stopping devices. Every now and then some road—the New Haven generally does after an accident—offers a large sum for the invention of a device that will protect the passengers even if the trainmen fail in their duty. But in every case there is some fault to be found with the device presented, and nothing more is heard of the matter.

"There are at present several automatic train-stopping devices in successful operation, notably the one used by the Interborough Rapid Transit Company on the express tracks in the subway. For years it has been doing its work silently and efficiently, and whenever a motorman has sought to run past a danger signal, the current has been cut off and his train brought to a stop in spite of himself. If ever the device has failed to work, it has erred on the side of safety, for no train can run by it unless the device is in perfect working order.

"One naturally asks why some such device as that used in the subway is not installed by the steam railroads. Railroad men say that, while the device works perfectly in the subway, snow and ice would interfere with its operation out of doors. But why should passengers be without the maximum protection during most days in the year merely because in the comparatively few days when ice and snow interfere, extraordinary attention to signals might be necessary?

"There are mysteries in the operation of railroads that the ordinary person can never solve, and the greatest one, perhaps, is why such a shocking lack of even the commonest intelligence is frequently displayed by the men who are paid thousands of dollars a year to manage the properties. As far as the automatic train-stopping devices are concerned there would seem to be only one good reason why the railroads do not want to install them. They want their engineers to keep up to schedule time. They do not want any automatic device to stop them in their rush against time, even though they flash by the danger signals."

The Full Train Crew in Missouri.

The Missouri Legislature at last session passed a full crew train act which requires that freight trains consisting of 40 or more cars shall be equipped with a crew consisting of at least an engineer, fireman, conductor, flagman and two brakemen. The railway companies hold that with trains equipped with air brakes, the new law imposes upon them the employment of useless trainmen which will increase the cost of operating $500,000 annually.

The railway companies of Missouri have determined to fight this full crew law, and they are making an appeal to the people through a referendum vote. That vote will not take place till October 1914, so there will be ample time for consideration of arguments for and against the measure.

Railroads Want More Revenue.

The agitation that accompanied the claims made by the engineers and firemen for higher pay seems likely to secure railroad companies some compensation for the increased expenditures they have been compelled to make. The rule of the past has been for railroad companies to keep reducing rates to comply with the combined demands made by shippers, but when they attempted to take the other track, they were met with howls of opposition which seemed to be echoed by the Interstate Commerce Commission which held the casting vote. Two years ago and four years ago the railway companies made requests for permission to make a modest advance in freight rates, but it was met with violent opposition from the press and the public, and had to be abandoned, the Interstate Commerce Commission taking sides with the opposition.

Against Prison Goods.

The labor unions have carried on a long and persistent crusade against prison-made goods being put upon the open market, and there seems to be some prospect of their being successful. A bill has been introduced into Congress by John J. Nolan, representative from California, which prohibits all interstate transportation of "goods, wares and merchandise, manufactured, packed, produced or mined, wholly or in part by the labor of convicts or in any prison or reformatory."

It is made the duty of the Secretary of Labor to issue a published report of all penal institutions producing convict-made goods, which may be transported in interstate commerce. In this report are to be published the names and addresses of all contractors and dealers in such products.

Any such dealer is authorized to stamp non-convict-made goods in which he deals, as registered under the act, but without such a label merchandise from handlers of convict-made goods is shipped at the peril of the shipper or transportation company. Penalties of fine and imprisonment are provided for knowingly aiding in interstate transportation of all convict-made goods.

The act exempts from its operation all states which restrict by law prison production, to articles for state, county or municipal consumption only.

The bill is the ninth measure introduced on the Progressive National Congress programme, and has the approval and support of influential labor leaders. It is in fulfillment of the Progressive party pledge to work for "the abolition of convict contract labor system; substituting a system of prison production for governmental consumption only; and the application of prisoners' earnings to the support of their dependent families."

In working out the provisions of this bill, Representative Nolan has had the aid of members of the Legislative Reference Committee of the Progressive National Service, including particularly Dr. Walter E. Weyl, Professor George W. Kirchwey of Columbia and Dean William Draper Lewis of Pennsylvania.

New Haven Engineers.

There is no real mystery about the cause of collisions on the New York, New Haven & Hartford Railroad when heavy fast trains are run with eight minutes between sections. The company's operating officers have been trying to find other excuses for the prevalence of collisions and they have alleged that the agreement with the enginemen to regulate promotion by seniority has been the means of putting upon express engines, men deficient in experience. A charge of this character was made by General Manager Bardo, who sent to the engineer's committee a letter containing a draft of proposed changes in rules in accord with the recommendations of the Interstate Commerce Commission for "immediate establishment of safer and more efficient operation," and of the Public Utilities Commission prescribing physical examinations and other tests.

Chairman F. S. Evans of the engineers' committee, in his reply to Mr. Bardo's proposal to abolish the seniority rule of advancement, says:

"Why does not the New Haven go back to the conditions prior to the fall of 1911 without attempting such radical changes in relation to its engineers? Under the same rules of operation the New Haven from 1901 to 1911 was as safe as any in the country. The present seniority rule was made in 1901. The personnel of the engineers is virtually the same today as immediately prior to 1911. For eight years or thereabouts the New Haven was operated safely. It carried more than five hundred million persons with only one fatality.

"In the fall of 1911 came a change. Henry J. Horn, who succeeded S. Higgins, as general manager, at once ordered that engineers make time. 'Time must be made,' the order read. If an engineer was a minute late, he was jacked up. The first time his engine ran by a signal, the engineer was summarily dismissed. The

ambition was to make a record of trains on time over any railroad in the country. The orders put out in the fall of 1911 made the New Haven travel unsafe and demoralized the esprit de corps."

As to the proposed change from the "practical" to the "scientific" test of vision, Mr. Evans points to the record prior to 1911 of the engineers of the road.

Objection is made to a change in the discipline of the road. The committee points out that it wants the right of appeal at any time from the decision of a division superintendent and the mechanical superintendent. The reply on this point says:

"The rights of the engineers have progressed too far to give almost unlimited power to a division of mechanical superintendent."

Against Child Labor.

Ohio should be a better place for children to live and work in this month, when the last Legislature's amendments to the child labor laws go into effect.

The minimum age limit will be increased to fifteen years for boys and sixteen for girls. Employment of boys under fifteen and girls under sixteen will be prohibited in mills, mechanical establishments, tenement houses, offices, boarding-houses, bootblack stands, public stables, garages, laundries, places of amusement, clubs, brick or lumber yards, in the distribution, transmission or sale of merchandise, in the construction or repair of buildings, in the transmission of messages, or as drivers.

School certificates will have to be procured by boys under sixteen and girls under eighteen. It will be unlawful to employ boys under sixteen and girls under eighteen more than eight hours a day and six days a week.

In establishments where boys under fifteen and girls under sixteen are prohibited from working, boys under eighteen and girls under twenty-one shall not be employed more than six days a week, 54 hours a week, 10 hours a day, nor before 6 a. m. or after 10 p. m.

Girls under twenty-one will be prohibited from employment that compels them constantly to stand. No boy under sixteen or girl under eighteen will be allowed to work in a theater. Persons under twenty-one will not be allowed to work in saloons.

It is good to see Ohio making progress in the cause of industrial humanity; at the same time Georgia, which has the most inhumanly unjust laws towards labor, has recently rejected a measure aimed at reducing the hours of child labor. But when Georgia was once a slave State and its politicians have not got over the habit of treating people who labor. But then Georgia was once a respect.

Opposing Progress.

Locomotive firemen are not more superstitious or more easily discouraged than other classes of workmen, but they are rather too ready to imagine that any new device intended to lessen their toil or to make their work easier, is certain to end in reducing their pay. When petroleum first began to be used as fuel some alarmists predicted that the engineer could be made to do the firing and that the fireman's labors would be dispensed with. We all have learned long ago what that fear amounted to.

The history of industrial inventions tells that every improvement calculated to reduce human labor, has nearly always been received with fierce opposition by the people affected, and that the improvements always resulted in the workers being much better paid. Nearly every line of industry on which improvements have been affected gives illustrations of this truth.

The mechanical stoker for locomotives is becoming slowly perfected, and the day is not far distant when all heavy locomotives will be equipped with one of these labor-saving inventions. We hear the assertion repeatedly made that many firemen are doing their best to prevent automatic stokers from working successfully. We believe that such reports are exaggerations, and we have been assured that on some railroads firemen have given valuable suggestions in the development of mechanical stokers; but there may be some firemen who oppose ideas of progress which is foolish and represents the same kind of sentiment that led to smashing of spinning jenneys and the breaking up of power looms in the long ago. Nothing but disappointment will come to those who oppose progress in the calling they follow.

Obnoxious Laws.

When a State Legislator is hankering after the notoriety that will help him to undeserved re-election, he has generally found that attacking railway interests was the cheapest method of achieving popularity. That line of action has been losing its popularity of late, for even granger voters are learning that impoverishing railways reduces the efficiency of transportation facilities.

Some of the legislatures have recently found a new fad called eugenic regulations concerning marriage, which they are turning into laws that are disgusting inquisitions that no respectable person ought to be subjected to. Certain publications have been loaded recently with discussions of eugenics being a case where fools run in where angels fear to tread. Unscrupulous ruffians are striving to give open publicity to delicate matters that respectable and right thinking people keep out of sight. We wonder that women's organizations fail to oppose this marriage eugenic craze, but it is throwing a new obstacle to easy marriage from which the woman is always the keenest sufferer.

Pioneers of Modern Transportation.

The first electric transportation motor and car were built in a blacksmith shop in Vermont about seventy years ago. The motor was used to run upon a circular track for exhibition purposes, but it proved an excellent advertisement of the possibilities of electric power.

About the time that the Vermont blacksmith was scheming an electric car, Mathias Baldwin, of Philadelphia, was building a small model locomotive for use in the Peale Museum. That locomotive was put to work running round a circular track and was watched with great interest by the people of Philadelphia who had been hearing edifying discussions about the practicability of using steam engines to operate railroads.

Persistence of Ignorance.

Learned men are frequently impatient with ignorance and denounce the stupidity of people who are skeptical concerning the truth of scientific discoveries. Cherishers of ignorance have had many compatriots in the days gone by when intelligence was striving to dissipate ignorance. Lord Bacon who was regarded as being one of the wisest men of his day and generation, vied with obstinate skepticism and cold disdain, Bruno's theory of the earth's revolution around the sun and he regarded the theories of Copernicus as idle vagaries.

Verdict on the North Haven Collision.

Coroner Mix, who investigated the North Haven collision on the New Haven Railroad, returned a verdict that the engineer of the White Mountain Express which did the damage, and the conductor and flagman of the Bar Harbor Express, which received the shock, were criminally responsible for the accident. He alleged that Engineer Miller ran his train "recklessly, unlawfully and at a high rate of speed."

Interstate Commerce Commission Report on New Haven Collision.

The Interstate Commerce Commission's report on the New Haven wreck at Wallingford puts the blame for the disaster upon the directors. It makes important recommendations for the immediate safeguarding of lines of passengers and urges the providing of an adequate method for obtaining a space or interval between trains pending the installation of the new block signal systems. It also urges the running of all trains under full control in foggy weather and a change in rules regarding the sending out of flagmen. This latter recommendation ought to apply to all railroads.

General Foremen's Department

Ladies' Auxiliary.

The ninth annual convention of the Railway General Foremen's Association is now a matter of history. The attendance was not as large as might be wished, but the absentees were the losers, for it was a very successful convention in every other particular. The papers read were of vital interest to every railroad man, in the mechanical department, and were a credit to the committees having them in charge. The supplymen excelled themselves in making their exhibits attractive and interesting, and the entire arrangements made by them this year exceeded by far those of former years.

A very pleasing feature in connection with this year's convention was the formation of a Ladies' Auxiliary to the General Foremen and Railway Supplymen's Associations. Several meetings were held in the rose parlor of the Hotel Sherman, resulting in their organization with the following officers: Mrs. H. S. Mann, first vice-president, Mrs. F. C. Pickard; second vice-president, Mrs. G. W. Reyer; secretary, Mrs. Wm. Hall; treasurer, Mrs. F. Baskerfield; page, Mrs. C. M Newman. Mrs. W. W. Scott is chairman of the Executive Committee.

The auxiliary starts out with forty members, and it was decided to hold the charter open till the 1914 convention. Their primary object is for the purpose of promoting more sociability among the members, and to encourage others to attend the conventions.

Lost Motion.

In addressing the General Foremen's Association, Mr. Robert Quayle said: "I said to my chief clerk yesterday: 'Mr. Seibert, what would you suggest that I say to the general foremen's meeting tomorrow?' He said: 'I don't know.' Then he looked at me wisely and he said: 'What about lost motion?' That is a word that appealed to him and appealed to me. In these days when we have these large locomotives, when we have such heavy reciprocating parts and we have to have such heavy rods, large crank pins and large appliances and parts, it means that we are constantly carrying around in this manner tremendous loads, and when we get a tremendous power up, that engine exerting through the force of the steam on the piston, when she comes around there if there is any lost motion it is a thud, and each one of these thuds, used in the sense that I am using it which you can understand, is going to make for more lost motion, and it is going to be communicated to all parts of the engine. You understand that that lost motion ought not to exist; that by proper supervision and good workmanship that ought to have been eliminated before that engine left the terminal. And if it ran smoothly and all the lost motion taken up, then your shoes and your wedges, driving boxes, main rods, brasses and all the rest of the things that go to make up the motion of a locomotive will work smoothly. You know that.

"You would say to me, if I should ask you anything like that: 'What we need is sufficient men in the roundhouse that we might be able to take up that lost motion and keep it up. But we cannot do it with the force we have.' We will agree that it ought to be taken up. There are lost motions in other places than in the one I have just mentioned. No doubt about that. The superintendent of motive power sits up in his office and looks over his expense account. And he says: 'My pay rolls in my shops and on the road are approximately one million dollars a month; it is pretty big. My cost of repairs are so much per mile run, or so much per thousand ton miles,' and then he begins to say, 'Why does it cost me so much?' And then the locomotive engineering and some others like my good friend to my right here (Dr. Sinclair), calls our attention to just what it cost last year, and they want to know why it cost us so much and why some other roads do it for so much less, and we have got to think about these things and we must get busy. Then we begin to look around for the lost motion. We begin first to question right at the head of the department: 'Who am I? What is my authority? What am I doing? What is my material costing me as compared with last year? What per cent. has my wages increased? How much has my labor increased on account of the larger parts that we have to handle? What have been the conditions on the road? Has my tonnage been equal or has it been lower which would increase my cost?' We are prone first to find fault with the other fellow, and I will guarantee you from personal knowledge that it does not so much belong to the fellow up in the shop as it does to the fellow up in the office. You might spend half a thousand a month down there, but it would not reduce the cost as much as it might in the other direction; but like the little drops of water that made the great rain storm, it all helps, and we have to go into the various avenues and search for the cause of the excessive cost, and then we go down to the shop, and we find a man going around and he may have his two hands far down in his pockets and he does not see very much of what is going on around him, but he sees us coming and he will say: 'Here is the old man,' and then they get busy.

"You see another fellow going down the shop and he is just going fast enough for somebody to notice him. That fellow has a good gait and a good carriage; that fellow's head is up in the air. Not so far up in the air that he has to look over the tops of the other fellows' heads. He passes this fellow and wonders if somebody has put salt on his work to keep it fresh. The general foreman says: 'What has been going on here? Haven't you got a time limit on this kind of work? Yes, what is it? This is the general foreman; I am just impersonating him now. I haven't anything to do with that. He calls the foreman's attention to it. That fellow says, 'I got to get 10 hours' work for 10 hours' pay and if I don't there will be something doing,' and he goes away and he does one of two things—he either agrees to resign or he agrees to make good. I want to tell you men we all like to make good, but you can do it in a kindly spirit, and it must be done in a kindly spirit, because if you do not we will lose out. You will lose out. Take up the lost motion everywhere."

Counter-Balancing.

A number of questions has come to us lately on the subject of locomotives slipping while drifting, and while there are a number of causes of slipping one of the most common is in the improper counter-balancing of the wheels. Recent practice has almost perfected the calculation of the amount of weight necessary to place on the wheels so that their revolution is properly balanced, but it should be borne in mind that it is impossible to have any engine properly balanced at all times, because if it is properly balanced under steam pressure it will not be so when steam is shut off. The force that propels the engine is in the cylinder and not in the crank pin. It is, however, possible to counter-balance parts approximately correct so that excessive strain will not be imposed, the object being to balance the wheels almost perfectly while running, but to overcome a part of the

stress upon the crank pins when steam is shut off. There are nearly a score of different empirical rules in use for balancing and the results obtained by them have varied all the way from very good to very bad.

For engines with light reciprocating parts, about 50 per cent., or one-half of the weight of the reciprocating parts, are sufficient to balance, while with heavy reciprocating parts three-quarters of the weight are allowed for balancing. Each wheel should be balanced for all of its own revolving weight and its proportion of three-fourths, or other proportion used, of the reciprocating weight, this three-fourths of the reciprocating weight to be divided among the wheels in proportion to the revolving weight carried by each wheel. The calculations are usually done in the constructing or drawing room department, but experiments on balancing by machine shop appliances will show that the constructing engineer's work is not invariably correct.

Apart from the mere mathematical problem of exact counter-balancing, however, the slipping of wheels while steam is shut off and the engine drifting, with frequent consequent bending of rods and axles is another problem which no counter-balancing, however exact, can completely overcome. The reverse action of the engine by having the steam entirely shut off and the rods and crossheads and pistons being driven by the action of the crank pins sets up a motion so irregular and so full of variable shocks that unless the moving parts are very carefully adjusted the tendency to distortion is very great. This is a problem which has not yet received the careful attention that it merits, and it would seem from the complaints that have come to us that as the locomotives are increasing in weight, the effects of wheel slipping while drifting are becoming more marked and consequently calls for more serious consideration.

Harmony and Fitness.

Mr. Robert Quayle is a fruitful speaker when addressing railway men. The following are extracts from an address he delivered before the last convention of the International Railway General Foremen's Association: "General foremen hold an important position. You are the leader in your line. You are the leader of the work. You are the leader of the men. Your influence means a good deal. Your intelligence ought to mean a good deal. Sometimes we think that as one man we cannot do much, but one man can do a whole lot and we ought to determine that we will do the best we can and have things coming our way.

"I have one little line here and it is this: Are you a good instructor? There is a good deal in that. You have had some teachers in your time that could say something to you or ask you a question in a cynical manner that would stir up all the ire in you and you would resent it. He made an impression but it was not a good one. He did not know your disposition. If you have foremen under you, you ought to know their dispositions. You ought to be able to teach them without touching under the lower rib, and you are not a good instructor if you cannot do it. You may have some men that you cannot treat that way, and if you have, the best thing is to relegate him to the rear, because you must have harmony, and you must be the leader to work with them and get them to work with you. If you do that you will have a very good knowledge of the men who are associated with you in each department. By and by somebody higher up is looking for a man to take some important job. You may be the fellow he has his mind's eye on, but you are filling such an important position that the fellow next to you in the shop—he is not as good a man as you, not nearly—He says: 'I can't take a chance on that. I am not going to take a man out of that position and lift him up a notch higher until we have somebody here in the ranks that will take his place.' Some of us sometimes feel that it is not a good thing to have that kind of a man right next to us. We get jealous and afraid that he will get our job. Jealousy has no place in a workshop, nor anywhere else. I want to tell you that the man who succeeds in getting men who are in every particular better men than he is, will succeed, and if I cannot get a man for my associate who is a better man than I am, I won't have him. He must be a better man than I am in every way. At least I must think so, and when I have got him there what does he do with me. I get a force around me then and support that is as staunch as the very heavens above. Let us get men about us that we know are our superiors. That is not reflecting on you, either, when I say it. If I have a man who has good men about him, I know he has the fellows that are doing the work.

"Have you got your eye on good material, on good men—all the time to fill the positions that are becoming vacant by men who are being moved up or leaving the service? Have you got it down some place 'John Jones and James Brown,' and get them up according to their ability to do things. You ought to have and I have no doubt you do have. Don't you know it is the hardest thing in the world for men to pick out men to fill the positions higher up. A good deal of training is necessary and you men ought to have these men down at the beginning that have the intelligence; that have the moral fitness; that have the mechanical fitness. I said 'moral fitness,' and I want to tell you that you do not want to put any man into a position of trust who is over a lot of other men, unless he is a clean man."

Crosshead Clearance.

When adjusting a main rod to the proper length, always observe whether the key in the back end is in front or behind the crank pin. When in front the rod is lengthened, as the brass wears and the key is driven down, and when behind the rod is shortened. The clearance should be divided with a view to meeting and equalizing these unavoidable contingencies.

Another point that should be remembered is the space occupied by the area of the piston rod, unless the piston rod passes through the front cylinder head, making both ends of the piston rod space alike. In the ordinary piston the back end should have 1/32 inch more clearance than the front end to equalize the amount of the exhaust. In the roundhouse it is frequently necessary to disconnect a main rod and put it up again. When the engine cannot be moved to the center, it is necessary to scribe a line on the guides at either end of crosshead before disconnecting and observe that the crosshead remains in the same position when connected.

Tapping Holes True.

In tapping holes on any level surface, use a square to keep the tap true, the eye, however experienced, is not to be trusted. Some clever mechanics fall into the habit of trueing their work by window frames and other portions of buildings. These are not always reliable and the effect of perspective diminishes the object with which the comparison is being made. When tapping holes in a boiler or other circular work, lay off the hole, then describe a circle of any convenient size, and when the tap is well entered try dividers from the end of the tap to various points of the circle and observe that the tap is being kept equidistant from the circle.

Large Electric Excavator.

A Lidgerwood-Crawford electric excavator of unusual size is under construction. This machine will have a boom 100 ft. long and will be equipped with a bucket capacity of 4 cu. yds. of earth. It will be operated by 440-volt 60-cycle three-phase motors.

To possess things and never allow them to possess us—this is the essential part of morality.

No man is utterly alone, as long as he can forget himself.

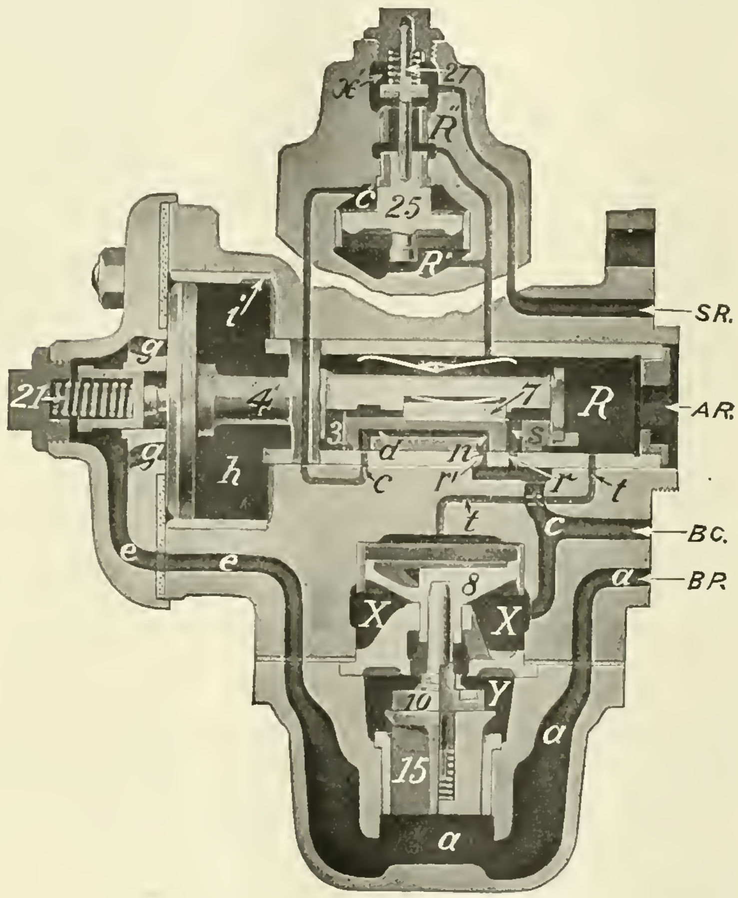
Air Brake Department

Brake Equipment L. G. N.

In an effort to prepare a series of articles leading up to a description of the "Universal" type of brake for passenger cars in steam road service, we are convinced that a thorough understanding of the equipment will be obtained only through a study of the improved features of the pneumatic brake systems before electric transmission of the operator's intent became a necessity, or as an example—the brake valve is provided with direct and equalizing exhaust ports for service operation, collapsible type of equalzing discharge valve and reduction limiting features before electric connections are considered. Similarly the car brake equipment is brought to a state of pneumatic perfection before electrical additions are contemplated and our readers are familiar with the conditions of service and braking power problems which necessitated an improved brake of the L. N. type which was improved upon through the L. G. N. equipment, and when weights of cars and train speeds increased beyond the limitations of a single cylinder and triple valve equipment, the P. C. equipment resulted.

During 1911 considerable space was devoted to a description of the P. C. brake, distance of train stops and the braking power problems which from a viewpoint of safety made the P. C. equipment a necessity in certain classes of service.

At this time it is desired to touch upon the development of the triple valve of the L. G. type beginning with the type L. valve, our readers understand what is meant by quick service, graduated release, quick recharge and high pressure emergency features, and only one view of the L. triple valve is shown for the purpose of comparison. Graduated release, high-pressure emergency and quick-recharge was made possible through the addition of a supplementary reservoir and at the same time certain undesirable effects were encountered which were eliminated in the L. G. triple valve, particularly so the difficulties in releasing brakes when unusually high cylinder pressures were developed.



TYPE L. TRIPLE VALVE IN EMERGENCY POSITION.

The L. G. valve retains the improved features of the L. valve and provides the maximum degree of flexibility that can be attained with a triple valve without the use of electricity.

The maximum permissible retarding effect for satisfactory service operation is based upon the light weight of the car and is taken somewhat arbitrarily, while for emergency operations braking power can safely be increased, hence one of the principal objects sought in the development of the L. G. valve is the greatest possible difference between service and emergency brake cylinder pressures without separating service and emergency features.

For several reasons it would be impractical to increase hrake pipe pressure beyond 110 lbs. per square inch, and in service the L. G. triple valves will develop approximately 105 lbs. cylinder pressure from 110 lbs. brake pipe pressure when used in emergency position, and it becomes evident that an ordinary method of release of such abnormal pressures from the brake cylinders would be decidedly difficult, hence a special provision is made. The diagrammatic and sectional views will serve to show the operation of the triple valve, how the pressures are obtained and how the release is accomplished.

Referring to the release position of the "L. G." valve the auxiliary and supplementary reservoirs are charged from the brake pipe through the usual feed-groove and past a check valve, there being no pressure in the brake cylinder, the intercepting portion contains atmospheric pressure, while the high pressure piston is open to the atmosphere at the upper end, and supplementary pressure is effective on its slide valve and equalized, through a small port with the chamber shown at the bottom end in the distorted view, the sectional views will, however, show that this piston works on a horizontal plane.

The flow of air to the relief portion will be shown in second service position.

If brake cylinder pressure is being exhausted it flows past the central portion of the intercepting valve, then through the cavity of the high pressure slide valve, then through the slide valve and graduating valve of the main piston to the atmosphere. This flow can readily be traced by a glance at the diagrammatic view of release position.

When an application of the brake is desired, the usual brake pipe reduction permits the auxiliary reservoir pressure to force the main piston and slide valve

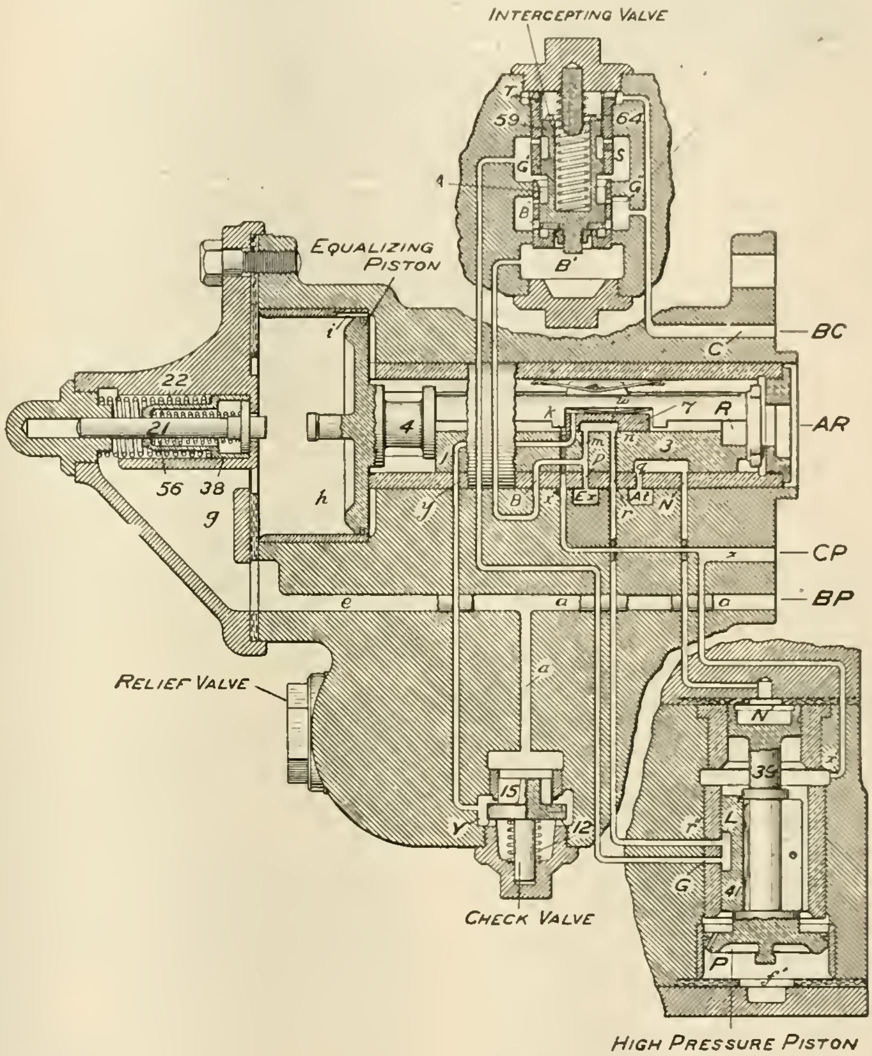
to application position, which cuts off the supplementary reservoir, admitting auxiliary reservoir pressure to the brake cylinder via the high pressure piston slide valve cavity and the intercepting valve. Whether the main slide valve assumes quick service or full service position depends upon the number of cars being operated and whether the slide valve is in quick service or full service lap when the brake pipe reduction ceases depends upon the position assumed during the application. This action of the type "K" triple valve is so well known as to require no further comment save that in quick service position air from the brake pipe enters the brake cylinder past the check valve 15. The graduated release is accomplished as with the type "L" triple valve. If the brake pipe reduction is rapid enough to carry the piston and slide valve past full service to second service position, the service ports are blanked and auxiliary reservoir pressure flows through ports "Z" and "D" to the relief valve portion, thence through suitable ports and cavities past piston 70 to a cavity in the slide valve on piston 85 to a cavity "B" raising check valve 91 which leads to the brake cylinder, and when auxiliary and brake cylinder pressures are equal, the spring 92 seats the check valve. Brake cylinder and auxiliary pressures then being equal in the chambers at either side of piston 85, the spring 95 forces the piston and slide valve to the right and the exhaust cavity of its slide valve opens the auxiliary to the atmosphere. This sudden drop in auxiliary pressure then permits the graduating spring to force the main piston to second service lap position in which there is no further flow through port "Z," it being lapped by the graduating valve until a still further reduction again opens port "Z" and the operation and exhaust of auxiliary pressure is repeated.

This feature prevents the full travel of the main piston and a consequent emergency application when it is not desired and when brake pipe pressure is restored and the main piston moved to release position, brake pipe pressure moves piston 85 and its attached slide valve to its normal position and the supplementary reservoir is connected with the auxiliary giving a prompt recharge.

When the brake pipe pressure is suddenly reduced, the main piston is forced to its full stroke or emergency position. In this position auxiliary reservoir pressure flows through a port "B" in the slide valve seat to chamber "B," unseating the intercepting valve and promptly equalizing with the brake cylinder when spring 64 instantly returns the intercepting valve to its normal position. At this same instant the main slide valve exhausts the pressure from the outside of the high pressure piston, and the supplementary reservoir pressure constant on the inside of the piston forces the piston down and admits pressure to the quick action piston, unseating it, and the quick action valve which exhausts brake pipe pressure to the atmosphere continuing the emergency application throughout the train.

The same movement of the high pressure piston admits supplementary pressure to the chamber "G" of the intercepting valve and flows to the brake cylinder as the intercepting valve is forced to its seat by spring and brake cylinder pressure.

The release after an emergency application is made in the usual manner, but at the first movement the brake cylinder is opened to the lower pressure in the auxiliary reservoir through the intercepting valve, thus assisting momentarily in the recharge, and immediately thereafter the high-pressure piston operates to cut off the brake cylinder pressure from the auxiliary reservoir and exhaust brake cylinder pressure to the atmosphere, thus releasing the brake.



L. G. TRIPLE VALVE IN RELEASE POSITION.

This entire action is practically instantaneous and in this manner the auxiliary and brake cylinder equalize when the auxiliary is cut off and the supplementary pressure entering the brake cylinder raises the pressure to within about 5 lbs. of the initial pressure contained in the supplementary.

The quick action piston is returned to its original position by brake cylinder and spring pressure, and the high pressure piston is returned to normal position when brake pipe pressure is restored.

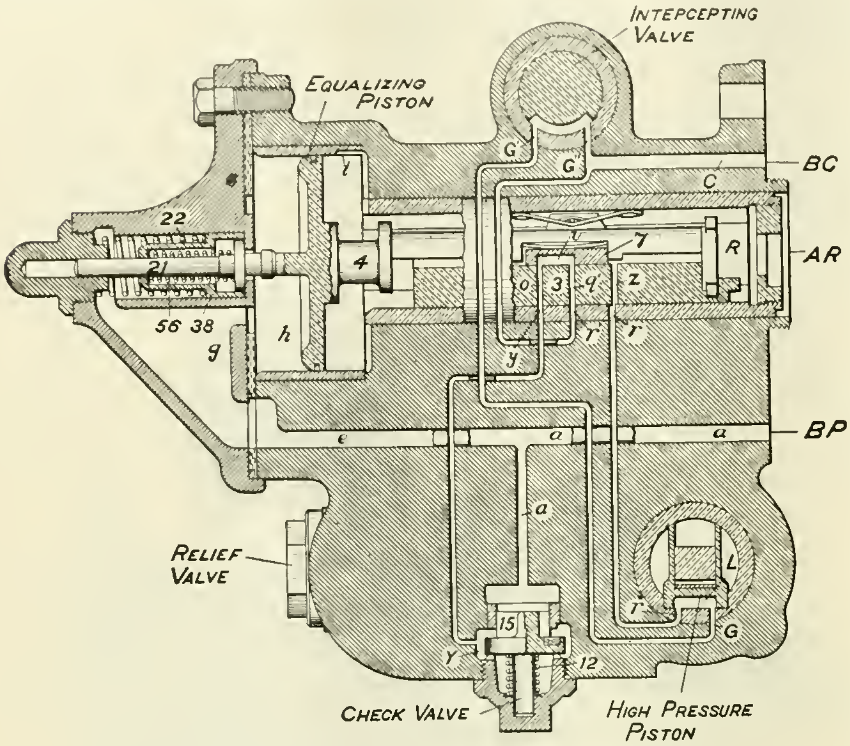
Through this arrangement the emergency application can be made at any time regardless of previous service applications.

Braking Power Problems.

The braking power problems that are presented from time to time through the introduction of heavier cars and locomotives, high rates of speed and increase in traffic are not generally appreciated by the average railroad man. If an increase in the weight of a car required but an additional number of pounds brake shoe pressure to produce an adequate braking force, there would be no complicated braking power problem to deal with, and no doubt the required force would be secured by means of additional cylinders or increases in total leverage ratios.

In order to meet present-day requirements an air brake equipment working at

its maximum efficiency must bring a train to rest from a 60-mile per hour speed in a specified distance, and the shortest



L. G. TRIPLE VALVE IN QUICK SERVICE POSITION.

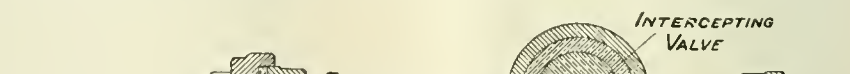
possible distance increases directly, all other conditions being equal, with an increase in the weight of the car or locomotive.

While many other conditions are important factors affecting the distance in which a train of cars can be stopped with an air brake equipment, rate of speed being the chief consideration, it is desired to ignore all of the component factors, except the weight of the car and locomotive.

By comparing records of air brake performance in reference to distances in which trains of cars have been stopped, it will be observed that a train running at the rate of 60 miles per hour could be stopped in a distance of about 1,050 feet from the point of application by the quick action automatic brake, but this was accomplished 30 years ago and with the same train and equipment it can be duplicated and no doubt be improved upon at the present time, but about 10 years ago the use of a high-speed brake became a necessity and while this was a more powerful and more efficient brake, the distance in which a train of cars could be stopped from the 60 m. p. h. speed, increased to from 1,500 to 1,800 feet and in some cases to 2,200 feet.

About seven years ago the use of the L. N. equipment brought the distance of a train stop from the same rate of speed back to 1,300 and 1,400 feet, depending upon conditions, and the L. G. N. equipment was still an improvement, but within the past five years the P. C. equipment was developed and by its use the modern train of passenger cars can be stopped from a 60 m. p. h. speed in 1,100 feet distance.

Incidentally, air brake men have finally come to agree that for present-day passenger service a triple valve is a thing of the past, having marvelously served the purpose for which it was intended.



L. G. TRIPLE VALVE IN SECOND SERVICE POSITION.

Obviously there is some definite reason why, in spite of the many improvements in brakes, the length of train stops has materially increased and the chief reason is a constant increase in the weight of the cars and locomotives.

Just why the increased weights so markedly affect the efficiency of the brake is the problem we desire to comment upon at the present time.

As air brake men we have been taught that the solution of an air brake problem necessitates, among other considerations, first, a knowledge of factors and fundamental principles, and to find those involved in each particular case requires a system of reasoning, elimination, substitution, analysis and deduction and when the fundamental principles are recognized and used as a basis we can build, with mathematical precision, upon a reliable and accurate foundation.

The fundamental law of the science or art of mechanics is the conservation and transformation of energy. Scientific men, according to a well defined system of reasoning, agree that during the formation of the earth a certain amount of energy has been stored, it may be expended or transformed in the earth's movement, some of it is necessary to force a plant out of the earth and into space during its growth, but it is understood that man cannot add to or create any energy. All that man can do either physically or mechanically is to transform portions of this energy and never from a lower to a higher order; that is, man can transform the potential or dormant energy to an active or kinetic energy but always at an

enormous loss of the original through transformation.

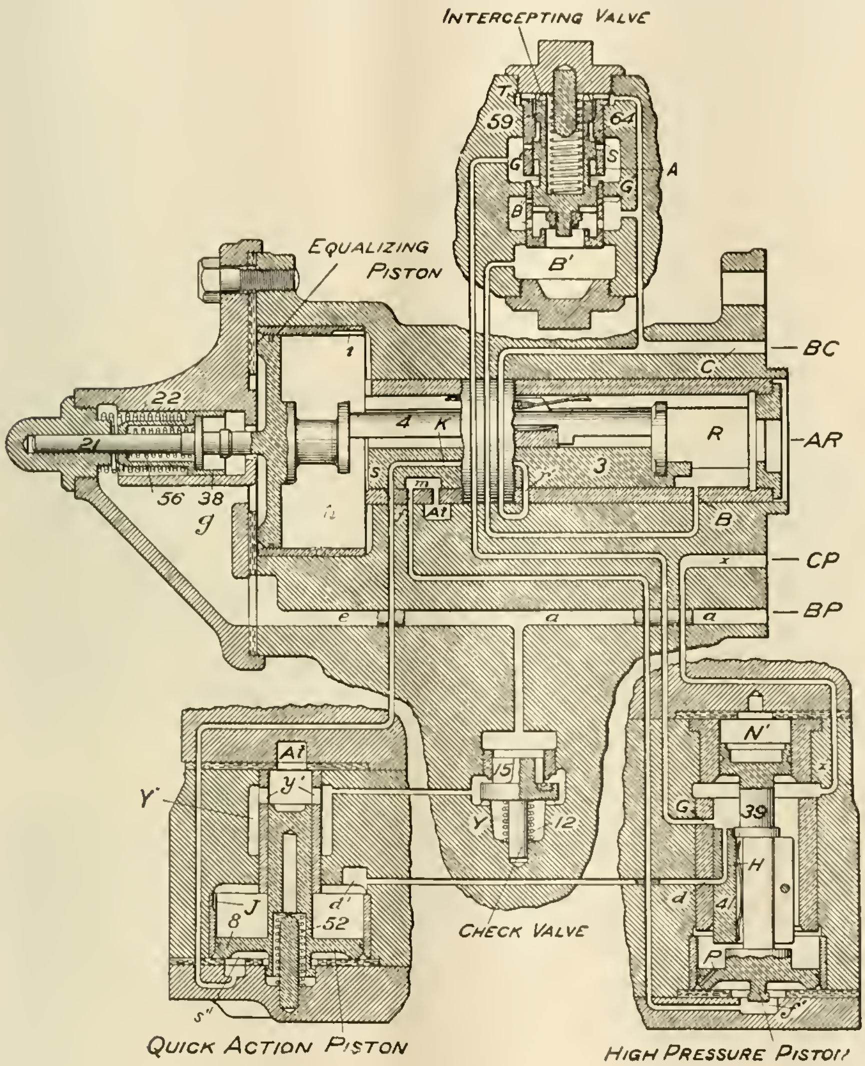
The intent is to say that a certain amount of energy can be stored in a band saw or in the flywheel of a stationary engine, but the energy expended in storing it is greatly in excess of the amount that can be utilized for working purposes.

The energy expended by the locomotive in service is derived from the coal which is converted into heat and the coal derives its energy from the growth of the substance of which it is composed and well informed men agree that less than 1 per cent. of the stored energy of the coal can be utilized by the most modern locomotive, hence in our more or less loose financial system it is sometimes possible to get something definite out of practically nothing, but mechanically it is impossible, for every ounce of energy expended means an enormous loss from some other source of energy.

This is the law or rock upon which splits the inventor who presumes to revolutionize things mechanical without finding fundamental principles

In air brake work we are not unduly concerned as to the source or creation of energy nor in the conservation insofar as to whether man is able to destroy or dissipate any energy (which he is not), but we are concerned with the energy developed by the locomotive and stored in itself and the train it hauls and know that it must be dissipated or transformed before the train can be stopped, or as a homely illustration, a brick can be carried to the top of a building, thereby storing in it the energy expended in carrying it, then the stored energy can be dissipated almost instantly by dropping the brick to the earth or be gradually expended by carrying it back; similarly the energy stored in the moving train can be allowed to dissipate through journal friction and atmospheric resistance or be compelled to dissipate in a few seconds time by the application of the brake; in either case nature is only concerned in the transformation or liberation of the energy stored, regardless as to whether it is done in seconds or hours.

Outside of that lost through internal friction, journal friction atmospheric and rail resistance all the work done by the locomotive or energy expended is stored and must be dissipated before the train can stop, hence we are concerned with the amount of energy we have stored when a train is to be stopped in a certain distance from a given speed.



L. G. TRIPLE VALVE IN EMERGENCY POSITION.

The amount of energy stored in the train is usually found by multiplying the weight of the mass in motion by the speed in miles per hour.

Thirty years ago a train of five cars and locomotive running at a speed of 35 m. p. h. contained about 4,900 foot tons energy, today 12 modern cars and two powerful locomotives running at a speed of 80 m. p. h. contain about 186,000 foot tons of energy or a modern train at a high rate of speed; the work done by the brake in stopping a train is sufficient to lift a 1-ton weight 48 miles in the air or the energy dissipated in stopping the train would raise a weight of 730 tons 350 feet in the air, or stated in another way this expended energy is sufficient to run a street car about 66 miles distance.

The most effective method found for dissipating the energy thus stored in a train is the application of a cast iron brake block or brake shoe to the surface of the wheel which creates a friction tending to check the rotation of the wheel, which in turn develops a retarding force between the wheel and the rail which eventually brings the train to a stop.

Practically the same methods and materials were used 30 years ago and from certain points of view it may appear to be an inefficient mechanism, yet the methods have not been improved upon. Many attempts have been made to improve upon the composition of the shoe, but to date the soft cast iron shoe for low speeds and the chilled cast iron shoe for high speeds are the best obtainable.

By inefficient mechanism from a certain point of view, we mean that for every thousand pounds force applied to the shoe only about 100 pounds of actual retarding force is obtained, or the average co-efficient of brake shoe friction is not much over 10 per cent.

While brake shoe and method of application has remained the same the weights of cars have increased from 20,000 pounds to 150,000 pounds and weights of locomotives (on drivers) have increased from 25,000, pounds to 400,000 pounds.

In spite of more wheels and shoes per train, the shoe must still do over 4 times the amount of work when stopping a modern train than was necessary when the lighter equipment was in service and applying 4 times the force in pounds on the shoe cannot produce 4 times the amount of retardation formerly obtained, because many ex-

periments have proven that the coefficient of friction obtainable decreases with an increase in pressure brought to bear upon the shoe, with an increase in the length of time it is applied to the shoe, and with an increase in the speed of the wheel.

All other conditions being equal, doubling the speed from 35 to 70 m. p. h. means that the train will run 4 times the distance before the added energy can be dissipated and the train brought to rest, and in this problem there are many other factors such as increased numbers and weights of parts of mechanism to be moved which absorbs power developed, and one of the most important factors is the time element, as the gages on the locomotive do not indicate what is taking place at the rear of the train, as in many instances the brakes may be fully applied at the head end of the train before they become effective at the rear and 110 pounds pressure on the air gage does not necessarily mean 110 at the rear of the train.

Reverting to the effect of increased pressure on the brake shoe, during a test of the late P. C. equipment, it was found that the enormous pressures developed resulted in some cases in wearing away one-fourth of an inch of the shoe during a single stop and that the high degree of heat generated through friction frequently warped the shoes in such a manner that but a very small portion of it would be brought to bear upon the wheel tread at the beginning of another or subsequent application, all of which tended to defeat the ends sought in shortening the stop.

Another factor which entered largely into the problem was the increase of piston travel (lowering of cylinder pressure) when cars were in motion, travels of 5½ to 6 inches standing frequently increased to 10½ and 11 inches under the influence of an emergency application at high speeds.

This braking power problem, which could not be analyzed in anything short of a volume, has been created by providence, nature, circumstances or necessity, according to your belief or opinion, but whatever imposed it has also provided two men with marvelous powers of conception and ability to whom it has entrusted the solution or who have from time to time conceived the absolutely essential means for safely controlling the enormous energies thus transformed.

We refer to George Westinghouse and Walter V. Turner.

With modern equipment the clasp, or two shoes per wheel type of foundation brake gear, greatly reduces or more than halves the brake shoe work, wear and heat generated, in fact, it has practically solved the shoe problem for the time being while the "Universal control" equipment provides for proper distribution, development and maintenance of correct pressures and the electric transmission of the operator's intent eliminates the undesirable qualities of the time element both as to application and release and makes possible the most efficient emergency brake obtainable.

The universal control is the improved electro-pneumatic brake and by its use the modern heavy passenger cars can be stopped from 60 m. p. h. speeds on level track in approximately 1,000 feet distance, which is as perfect in performance as any brake has ever been or probably ever will be, as all known laws, fundamental principles and elements of nature were considered in the design of the brake.

This brake, which has recently been subjected to a severe test in railroad service, will be illustrated and described in future issues.

Prosperity of Illinois Central.

The annual report of the Illinois Central recently issued shows the largest gross earnings in the history of the company. Referring to the disasters to the property which resulted from the floods of last summer, C. H. Markham, president remarks:

"The result of this interruption of traffic was not only the loss of considerable revenue, but it also caused a large expenditure in restoring the portions of the railroad washed out, and resulted in a congestion of traffic which was a very expensive and disturbing matter to both the company and its patrons.

"While the income account shows that the operating results for the year, considerably improved over those for the previous year, they are not equal to what had been hoped for; but month by month, improvement has been made and the results for the last few months of the fiscal year were decidedly encouraging, the net revenue for the month of May being larger than any other month of May in the history of the company, and that for the month of June closely approaching the highest net revenue in any previous June."

Rivals for Gasolene.

A statement was recently circulated through press dispatches that some one had invented a process for making alcohol from cellulose as being something new and important. Cellulose is found in all plants and is the essential constituent of the walls of the cells. There is nothing novel, however, in the proposal to make alcohol from that substance, for many processes have been patented for abstracting alcohol from cellulose, but so far they have not proved of any practical value.

With internal combustion engines designed purposely for the use of alcohol, it is probable that that spirit may be used economically in motors in competition with gasolene even at a price of 35 cents to the gallon; but experience will be required to demonstrate the relative cost of the two liquids for motor driving. As long as gasolene is cheaper per unit of work than alcohol, the cheap material is certain to hold popularity in spite of its undesirable characteristics.

Originator of the Steam Engine.

Although very little of a practical character had been done before the eighteenth century to develop the use of steam, thinking men displayed much interest in the problem centuries earlier. All readers of engineering histories are aware that Hero of Alexandria compiled a book about 200 years before the Christian era commenced, in which he described the Æolipile an elementary form of steam engine which had probably been in use for many centuries previously. The treatise of Hero remained practically hidden until 1547, when it was translated into Italian. The book attracted so much attention among scientists of that time that it was published in several languages and ran through eight editions.

When Hero's work was put in shape to be read by modern investigators, they began immediately to work out the problem of producing a practical steam engine. It took several centuries to develop a steam engine that would pump water, drive machinery and operate locomotives, but the credit of having pointed out the way belongs to Hero, the far-seeing Greek. He has received small credit for the work he achieved.

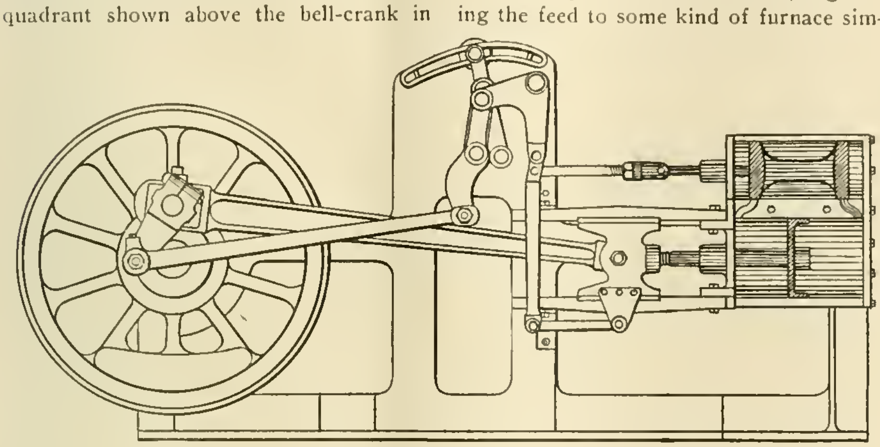
Steamer Obstructed by Cattle.

Our friend, Mr. W. S. Gray, of the Louisville & Nashville, sends us a clipping from the Cincinnati *Times Star* which gives an account of a river steamer being stalled by a herd of cattle. Mr. Gray calls upon some of our readers to invent a cow catcher suitable for steamboats. The article reads:

The Green and Barren rivers are rarely troubled with low water because of the locks and dams, but this season's drouth has broken all records. Captain Porter Hines, of the steamer *Chaperon*, vouches for this story: On the last trip down the pilot blew a whistle as if for a landing at Cole's Ferry, just below the mouth of Gasper. This was not a regular landing, and Captain Hines and other officers went on deck to find out about the matter. It was soon discovered that a half dozen cows had waded out in the channel to get cool and to rid themselves of the flies. They had effectually blocked the channel, and the deck hands were compelled to drive them to the bank before the boat could proceed on its way.

Baker Valve Gear Model.

Models of the Baker valve gear are being added to the instruction equipment on several railroads and we reproduce a drawing of a model furnished to us by Mr. G. Wallace Fordyce, a young machinist occupied in the Erie shops at Meadville, Pa. The gearing as shown in the drawing is arranged for the inside admission type. This is distinguished by the form and application of the bell crank which, in the inside admission type, has the upper arm pointing backwards. In the outside admission type of valve gear the upper arm of the bell crank points forward. It will also be noted that in the inside admission type of gearing the eccentric crank follows the main crank when the locomotive is running forward. In the case of an outside admission valve the eccentric crank is set a correspondence ahead of the main crank. The gearing is readily adapted to changes in organic structure and is rapidly coming into popular favor on many railroads. The sector or quadrant shown above the bell-crank in the model is not on the gearing, as applied to a locomotive, but is very convenient as applied to a model, as it avoids the necessity of using a reach rod with reversing lever and attachments, as in the model the gear may be placed in the forward or backward motion by loosening an adjustable screw attached to the sliding pin in the quadrant when the screw may be tightened at the desired place on the quadrant, the reverse being readily moved by hand.


BAKER VALVE GEAR MODEL.

Liquid and Other Concentrated Fuel.

The high price of gasoline and the demand for smokeless combustion are leading to various experiments with fuel and furnaces that will take the place of oil fuel. Powdered coal makes a highly efficient and smokeless fuel when burned, and furnaces suitable for its combustion, while gas produced by special means is giving promising results.

Our Glasgow agent, A. F. Sinclair, in one of his weekly contributions to the Glasgow *Herald,* writes about a liquid fuel producer as follows:

For the information of people not conversant with the principle of the gas producer it may be explained that the apparatus is a sort of miniature gas work. Coal is placed in a small storage bin, whence it is fed automatically to an enclosed furnace. When the furnace is lit the coal gives off gas, which is sucked by the action of the piston through some scrubbing material, by which all tar or other solid matter is retained. The cleansed gas then passes into the cylinder, and forms the fuel in the same way as ordinary illuminating gas is used in gas engines. When coal for this purpose is used on vehicles it has been found difficult to regulate the supply to the furnace with the accuracy necessary to produce satisfactory running, while the scrubbing process has not infrequently been found defective, the tar declining to stay behind entirely in the scrubber. But it has always seemed to me that there should be no insuperable difficulty in using heavy oils in this fashion, regulating the feed to some kind of furnace similar to that used on steamers for raising steam, and it creates no surprise therefore to learn that a producer on those lines has been brought into successful operation. The apparatus has been fitted to several Commer cars, but instead of the heavy oils, such as solar oil, which the writer had in his mind, the Southey producer uses a cheap grade of paraffin bought at less than 6½d. per gallon. In a recent trial under observation one of those vehicles travelled without the least trouble over a distance of 137 miles, including a long pull uphill on an average fuel consumption of 15 miles to the gallon.

Tin.

Tin is one of the oldest metals used for the convenience of man, being mentioned in the Pentateuch and obtained long before the Christian era by the Phœnecians from the British Isles, a circumstance which first brought the British Isles to the notice of civilization. The principal region of tin mines was Cornwall, but most of them have been exhausted and the modern source of supply is in the Malay Peninsula, notably Perak.

Tin is valued principally for its non-oxidizing properties which makes it a valuable covering for iron and steel, but it forms an excellent alloy. Although tin has proved itself an excellent preservation of other metals, it sometimes suffers from distempers that do not touch other metals.

Tin is a very strange metal with regard to this state of suspended change or "metastability." A severe winter cold will sometimes cause it to lose its hardness and crumble.

Objects made of tin often undergo such change and are then said to be suffering from "the tin disease." The contact of "diseased" tin with bright, hard tin is capable of setting up the transformation.

Steel Business Depressed.

A very reliable pulse of this country's prosperity has always been the condition of the iron and steel trade. The latest report of the United States Steel Corporation would indicate decided depression in that important business. The report says: "Unfilled tonnage on June 30 was 5,807,317 tons; on May 31, 6,324,322 tons; on April 30, 6,978,762 tons, and on August 31, 1912, 6,163,375 tons, making a decrease of 939,907 tons compared with last month.

"In view of the fact that for July the Steel Corporation reported a loss in unfilled orders of 407,000 tons, the decrease was smaller than was generally expected. Orders last month averaged slightly more than 31,000 tons a day, while production was less than 40,000 tons a day.

"The tonnage of August 31 was the smallest on the Steel Corporation's books since December 31, 1911. It was said that orders for September were running a little better than the August average."

Transportation by Camel Power.

There is some talk of introducing the camel as a beast of burden into certain western states, where the sandy soil approximates Arabia and other regions where the camel has been the principal medium of land transportation.

A camel has twice the carrying power of an ox. With an ordinary load of 400 pounds, the camel can travel from twelve to fifteen miles without water, going forty miles a day. Camels are fit to work at about five years of age, but their strength begins to fail at twenty-five, although the animal generally lives to be about forty years old.

The introduction of the camel will give a new field of imagination for the American joker, for he can kick like a steam hammer with a force that would make an army mule die of envy.

If our tastes did not reveal our character, they would be no longer tastes but instincts.

Traveling Engineers' Convention

INFLUENCE OF OPERATING DEPARTMENT ON FUEL SAVING.

An important report submitted to this convention related to the influence of the Operating Department on fuel consumption. The consumption of fuel per ton is variable says the report and dependant on many conditions, two of which come within the province of the Operating Department. When power is ready for service, fuel burned while it is waiting to be utilized, might be considered by the strict economists as being wasted as no direct earnings result from its use. Fuel burned during the time beyond that in which the train should be delivered at destination, under average favorable conditions, might also be considered wasted. The relation which the Operating Department has to economical consumption of fuel, lies in its control of the above two items through its connection with power utilization and its supervision of train movements.

The handling of power in connection with train movement is the chief duty of the Operating Department and upon the efficiency with which it performs these functions a low or high consumption depends. Its opportunities for aiding in keeping down fuel consumption, through betterments of many underlying conditions has an indirect bearing on promptness with which power can be utilized and trains made up and delivered. While credit is due any department, for fuel saving effected by its efficiency conditions, sometimes exist where two pounds of fuel might have been saved when only one pound was saved.

Sometimes it happens that a seemingly low fuel consumption is in reality a high consumption. For instance:

Two railroads run side by side, under the same basic conditions as to gradient, style of power, etc. On one line the fuel consumption per thousand ton miles has been one hundred and seventy-five pounds, which, by a supposed strenuous effort of the Operating Department, is reduced to one hundred and seventy pounds. The General Manager boasts to the General Manager of the competing line of this record and is informed that the fuel consumption per thousand ton miles on the competing line is but one hundred and fifty pounds. He investigates and finds the difference is due to such things as closer tab kept on reducing power in dull times, better judgement in assigning engines to run suited them, more attention to trackage at turn-tables, ash-pits and coal-chutes, up-to-date methods of handling ashes and coal to prevent delays, yards modified from time to time to expedite switching and making up trains, block signals arranged so as to be seen a good distance away, close supervision of despatching methods to prevent delays, rigid investigation of delays and prompt action to eradicate causes leading thereto; close attention to methods of inspection to prevent having to switch out bad order cars in terminal yard and enroute, scientific loading in relation to capacity of powder and weather conditions, judgment in regard to cutting down and filling out enroute, and in seeing to proper facilities for quick switching at such points; judicious selection of stopping and starting ground at water stations and at block signals where conditions may make stops frequent, and to betterments of similar imperfect operating conditions, most of which were within the power of his Operating Department to have bettered. In other words, his five-pound saving per thousand ton miles was but a crumb plucked from what might be termed "the table of operating extravagance."

This is an imaginary case intended to call attention to possible conditions which could be responsible for a higher than necessary fuel consumption per ton mile. Even where yard and road conditions are ideal, a good share of credit can accrue to the Operating Department for fuel savings through intelligent handling whereby trains are made up with least possible delay, handled with minimum amount of power, gotten over the road in the minimum of time, and power held at terminals the shortest time possible consistent with keeping up necessary repairs and with volume of company's business.

The most deserved credit that can be given the Operating Department for results that bring about economy in fuel is that due for betterment in yard and road conditions and in methods of despatching that go to make NEARLY PERFECT RAILROADING, when these betterments are due, or largely so, to the intelligence, aggressiveness and persistence with which that department worked to obtain same. The Operating Department is in a peculiarly fortunate position in that it obtains a double credit for betterments that reduce fuel consumption, as this can only be done, so far as this department is concerned, through betterments which are, in a major sense, for its own direct benefit in providing for more prompt utilization of power and more efficient train movement, and it has therefore a double incentive to work for such betterments.

A strong plea was made against the practise that some roads have of reducing the engines used in dull periods until those in service are unequal to the task of moving the freight. But on the other hand, waste results from engines being held a long time for trains to be made up. Objections were raised to the practise so common, of holding engines on the road through indifferent operating conditions. This hits that man, the train despatcher.

In storing engines, the practice was recommended of keeping those in service whose mileage comes nearest to the line of stopping. With poor power in service during dull periods, breakdowns are not likely to cause delay to other trains, as would be the case when business is rushing. Credit is due to the Operating Department when its influence is exerted to have maximum amount of repairs made during dull season.

Sections were then devoted to Turning of Power, Yard Terminals, Intermediates and Hump, important matters in train operating but of little influence on fuel economy.

Loading of power formed a more important subject. We believe, said the report, that power should be loaded to not more than 90 per cent of maximum capacity under best conditions which may vary with the weather. Fuel is wasted by underloading as well as by overloading. Where a grade on the division is not sufficient to justify pusher service, if trains were loaded so to make certain they would not stall on such grade, they would be underloaded over the rest of the division, causing considerable loss in ton miles and increased fuel consumption per ton mile. Local conditions should be carefully studied to determine most economical load for the territory. Makeup of trains as regards heavy and light cars is important, as the further from the engine the heavy cars are, more flange friction is increased on curves and the harder the train will pull. Efforts should be made to place heavy cars at head end of train. Judgment, however, should be used in order not to bring about bad braking conditions.

Prompt inspection of trains was urged and the providing of adequate facilities for such inspection and testing of air brakes before engine is attached, as arrangements for quick testing promotes fuel economy.

The remaining sections of the report

embraced Watering and Coaling Enroute, Block Signals, Train Despatching and Handling of Train Orders Enroute, Way Freight Trains, Pooled or Assigned Power, Running of Light Power, Sidings and Conclusions which were:

These problems and conditions, and undoubtedly others of similar import that members of the Association can bring up, are live issues. They have an important bearing on fuel economy from an operating point of view. The perfect railroad and perfect railroading do not exist and probably never can. The constant changing in business conditions, in power conditions, and in maintenance of way conditions, forbid the expectation of that Improvement is always possible where conditions are never perfect and the measure of credit due to the Operating Department for low fuel consumption per ton mile lies in the progressiveness, strenuousness and the persevering continuity of its efforts to bring about perfect operating conditions and despatching methods in its territory. Passive acceptance of existing conditions where such conditions are but indifferent, never raises the standard of efficiency. With railroads hampered, as they are today, by restrictive laws and rate-making legislatures and commissions, the recognized successful railroad men are those who can increase the company's net income by limiting the amount of its financial outgo, and in so far as the efforts of the Operating Department are successful in bringing about conditions that cut down the fuel consumption per ton mile, it need have no fear of not receiving the full credit thereof.

The committee was M. J. Howley, chairman, T. B. Bowen, J. C. Petty, J. W. Nutting, G. H. Travis, P. J. Miller.

Scarcity of space prevents us from publishing the entire report. We heartily recommend it to the attention of operating officers who may receive copies free on application to Mr. W. O. Thompson, New York Central Railroad, East Buffalo, N. Y.

New Alarm Signal.

An inventor who holds forth within hail of J. H. Maddy's office, general agent of the Erie, has a sensible scheme for preventing engineers from running past signals that might be installed on all the railways in the country without enormous expense. This inventor proposes installing a loud sounding gong on every locomotive whose voice shall be put into action by a connecting trip located on the track in a convenient position for operation by the signal. When the signal is at "clear" no tripping will happen, but should an engine or train pass when danger exists ahead, the alarm given will be so positive that no person on a train will fail to notice it.

Improved Fuel Oil Burner.

Mr. S. M. English and Mr. L. V. Edmonson, Renovo, Pa., have perfected a marked improvement on fuel oil burners. As shown in the accompanying drawings, it will be observed that the oil on entering the burner is spread by coming in contact with a conical-shaped metal projection,

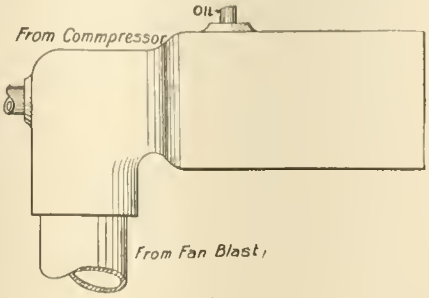


FIG. 1.

after which the oil is further spread by a corrugated inclined plane or baffle plate The oil is thereby spread before reaching the opening admitting the blast. With this arrangement in operation it is impossible for the oil to run back into the blast pipe. This has been the chief source of trouble with nearly all other kinds of

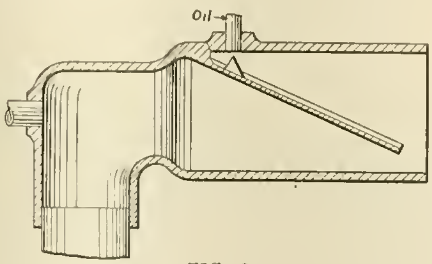


FIG. 2.

fuel oil burners. Repeated tests have shown that the improved burner, besides completely preventing any back blast, also effects a saving in the amount of fuel oil used, as the complete spreading of the oil before reaching the blast facilitates ignition, rendering a perfect combustion possible. Fig. 1, shows a general view of the burner. Fig. 2, shows a section view with conical projection and corrugated

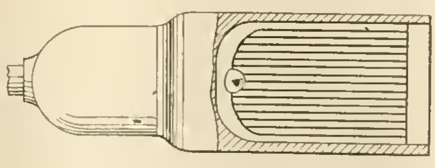


FIG. 3.

baffle-plate shown. Fig 3, shows another section view showing the corrugations on which the fuel oil is spread before reaching the blast.

Wants Oil Fuel.

A correspondent of the Buffalo *Evening News* says:

"I read of the movement to force engines entering the city to use oil for fuel and think it only right. The success of oil burning in the West and Southwest of the United States is the subject of an article in RAILWAY and LOCOMOTIVE ENGINEERING. If any one doubts the advantages from such use of oil fuel let him read this publication.

"If anything will do away with the smoky nuisance on railroads most any one would indorse it (providing it did not add anything to the cost of the ticket to pay for such fuel). Now is this the right spirit? Should not all be willing, and even glad to pay something to the cost of transportation since all benefit by the disuse of soft coal? Who that has traveled any distance has not been annoyed by the smell and dirty cinders flying from a laboring engine? I think the delight of clean travel would be worth from half a cent to a cent a mile. Some declare oil fuel makes for economy. I don't know anything about this myself, but would be glad to have somebody tell me. Perhaps the average traveler may question the odor of oil fuel and say that if it is anything like that which trails the automobile, it is as offensive as the cinders."

Oil Locomotives for India.

India, like the rest of the world, is suffering from an increase in the price of everything, including coal.

Hence, locomotive engine drivers there are considering the use of oil, and the adoption of oil engine locomotives has been seriously put forward in connection with the operation of the waterless track over which the Trans-Persian Railway would have to pass.

This, however, is very much in the future, but there are still many places in India where oil fuel would be seriously worth consideration. In order to test the matter thoroughly the Indian government is about to carry out an important series of trials on the Northwestern (State) Railway, and has made a contract for the supply of about 7,000 tons of oil for the purpose.

Half a dozen engines will be fitted in the first instance, and carefully trained crews employed, so as to insure a proper comparison being made between the practical values of Bengal coal and Persian oil under regular service conditions. It will, however, be at least twelve months before any definite results can be expected.

Changing Gears by Electricity.

Indications are that several of the foreign automobile makers will provide their cars with electrically operated gear-change mechanism. The usual gear lever and gate quadrant will give place to a push button placed at a convenient point, one button for each speed desired.

Electrical Department

The Dracar.

The "Dracar" or Drake Railway Automotrice is a self-propelled passenger car, using a gasolene engine to drive an electric generator as a prime mover, with the electrical energy transmitted to motors geared to the axles.

In other words the "automotrice" is a gasolene-electric car. The word "automotrice" is the term used in Europe, where the first important developments took place, and where this type of self-contained car began to receive serious attention nearly twenty years ago.

The trolley car had shown itself as successful, and the application of an independent unit for railroad service was desired to give steam road passengers the comfort and convenience of electric operation in Europe. It has many advantages over that of other gas-electric cars in that it is of greater simplicity, can be operated from either end, has a minimum weight per passenger and costs less for fuel.

The first important installation was in Hungary on the Arod-Csanad Railway. A service begun in 1905 has grown from 17 pairs of trains daily, under steam operation, to 72 pairs with automotrice operation. Although the fares were reduced the receipts have increased. This road has the distinction of being the first railway in the world to begin and continue the operation of an important system, by means of the so-called railway motor cars. During the seven years over 5,300,000 car miles were run, and the demand for a light, clean, flexible and easily operated car, which will enable railways to provide better facilities to their patrons and in so doing decrease the per diem or car mile expenditures for existing trains.

The power unit is remarkably simple and reliable. It is more of the automobile type of engine and can be easily cranked by one man, and mechanical starting means are unnecessary. One of the greatest advantages, and one which marks superiority is that perfect self-operation can be obtained in either direction. Since the power unit is at one end, it means that the unit can be controlled from a distant point, or the other end of the car.

An important consideration to any rail-

GASOLENE-ELECTRIC DRACAR ON THE MISSOURI, OKLAHOMA & GULF RAILWAY.

traction. High pressure steam cars of coal, coke and oil fired, and gasolene engines with direct mechanical transmission, from the engine to the driving axles, have been tried out. These trials have shown that electricity should be made use of, since no other means has been found which gives such high tractive effort or such a progressive and convenient speed control. The car with direct mechanical transmission to the axles from a gas engine mounted on the trucks cannot compare with the Dracar. The large number of parts makes it exceedingly difficult to prevent pounding of cranks, etc., and in consequence heavy maintenance.

The Dracar as exploited by the above company is the result of several years of successful development and commercial records of service and maintenance are well worth considering.

The car may be compared with a modern interurban trolley car, but with trolley removed and a power plant installed in the forward end of the car. The power plant shown by Fig. 1 consists of a multi-cylinder gasolene engine direct connected to a 500-volt generator, shown on the left of the photo, both of which are mounted on one continuous sub-base. The gasolene supply is carried in two tanks cross-connected and arranged so that either may deliver the gas to the carburetor. The cylinder water-cooling system is placed on the roof of the car, the hot water circulating through same. In winter a portion of the jacket water is circulated in the car heating system.

The whole car is designed to meet the road company is the possibility of operating the automotrice from either end at will. In a growing and developing community, it is frequently desirable to extend train service to another station or terminus where no wye or turntable exists. The rear platform of each car is supplied with duplicate controller, air valves, etc. The controller is arranged in such manner as to give the motorman control over the engine as well as the electric current generated by the group.

The photograph shows one of the Dracars built for the Missouri, Oklahoma & Gulf Railroad, where same has been operating between terminals of 30 and 50 miles. This particular car is 56 feet over bumpers and 9 ft. 6 ins. wide. The total weight complete is only 65,000 pounds.

The uses to which the Dracar may be put are various, but among the many are passenger and combination cars, private and club cars, inspection and office cars, parlor and buffet cars, and milk and produce cars.

The average branch line service on the steam roads does not fill a steam train, nor can it justify the expense of running one. Usually these trains are composed of engines and equipment considered obsolete for the main line service. The locomotives are notoriously wasteful and often in very bad condition. This branch line traffic thus ordinarily represents the most expensive per mile service on the entire road, while the receipts are often less than operating costs. For such cases the gasolene-electric automotrice is a wonderful relief. The actual operating costs are much less than with locomotive, without considering the collateral expense attached to steam service, such as roundhouse and terminal service, water tanks, coaling chutes with attendants, etc.

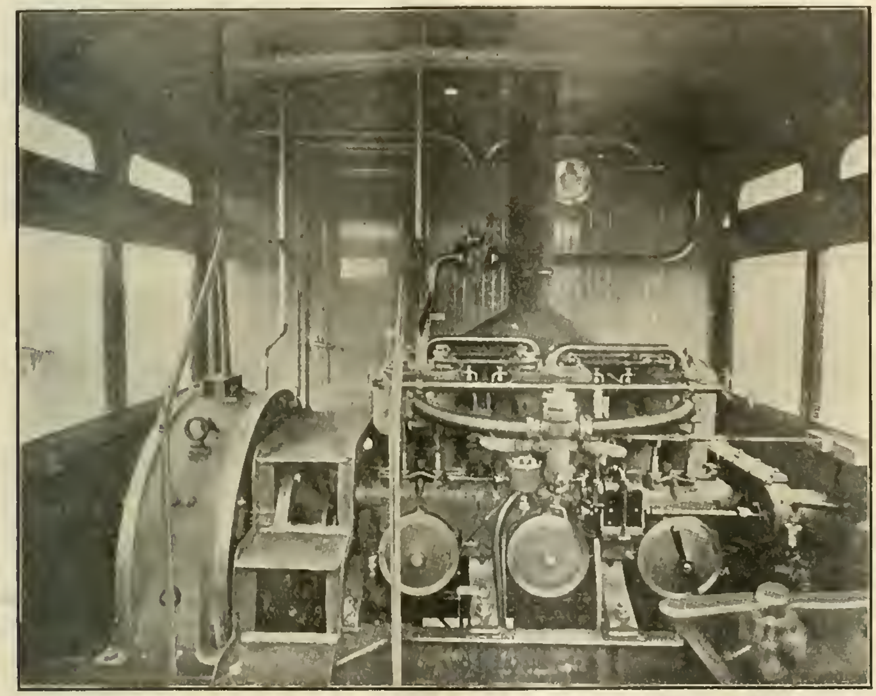


FIG. 1. PASSENGER CAR PEROLI GROUP SHOWING GAS ENGINE AND ELECTRIC GENERATOR.

The Electric Headlight.

The general tendency at the present time is to provide more light at the head-end of a train. Many states—Arkansas, Florida, Indiana, Kansas, Georgia, Mississippi, North Carolina, Oklahoma, South Dakota, Texas and Wisconsin—have laws requiring a headlight of several hundred candle power. There are in the neighborhood of 15,000 engines which run every night with one of these lights.

There are many arguments in favor of and against the bright light, of 1,500 candle power. On single-track road, with meeting points at several miles apart, the full advantage of the light is realized, for there is no question that the range of vision is greatly increased and the engineer will be able to stop or reduce the speed, thus eliminating accidents at cross-overs, etc. Again on a four-track road with a mass of signals, a bright light might be of great disadvantage, due to interference with light signals and the blinding effect to approaching trains.

The history of the headlight is very interesting. The earliest form used in England was a fire-basket filled with oil-saturated waste hung on the front of the engines. The first headlight in this country was not mounted on the locomotive itself but consisted of piles of pine knots, which were placed on a flat car, lighted and shoved in front of the locomotive. At first, night trips were avoided, but due to the necessity of carrying the mails a crude form of headlight was made, which developed into the common oil light as used today.

Those in favor of the powerful headlight say that it should be of sufficient power to reveal the form of a man 800 feet away on a clear night. A light of this character can be obtained by acetylene or by electricity. Indications from actual use favor the electric headlight. The great range of vision, which at times is over 2,000 feet, enables the fastest trains to stop. Actual tests made by the railroad companies, commissions, etc., show that trains can be stopped in practically a thousand feet when running sixty miles per hour.

It is claimed the advantages to be gained from the use of a good light are many. It adds greatly to the safety of operation. It can prevent collision on a single track, due to the reflection of an approaching train being seen at a distance. Of course the most important point in favor of the good light is that an obstruction or a person on the track can be seen.

The electric headlight has been criticised, but this criticism seems hardly warranted since the steam turbine which generates the electric current for the arc, is a reliable piece of apparatus. The arc itself is rugged and has an extremely low cost of repairs. The turbines are designed to operate on all steam pressures, ranging from 100 lbs. to the very highest and on superheated as well as saturated steam.

Automatic Sub-Station.

In Detroit is located a sub-station which is controlled from a distance. The apparatus may be said to be automatic, inasmuch as the various functions of starting, stopping and regulation are performed without the supervision of an attendant in the station where the machine is located. The knowledge that the machine has operated is conveyed to the operator by signal only.

The sub-station was installed by the Edison Illuminating Company of Detroit. It has a special automatic switch-board equipment, arranged so that the machine can be started, controlled and stopped from a distant point without any control wires, only the power wires connecting th sub-station to the main station. This sub-station has worked so satisfactorily that the company expects to extend this system to other sub-stations.

Frost Warnings by Telephone.

Many kinds of agricultural products and in particular fruit, are very liable to severe injury from sudden frost, even of short duration. To guard against the spoiling of its crops in this manner the Wood River Orchard Company, which owns extensive fruit orchards near Weiser, Idaho, has installed a novel system for giving frost warnings by telephone. Dial-type thermometers are located north, east, south and west of the orchard area and fitted with fixed and adjustable contacts which are arranged to close local circuits whenever the temperature drops to a certain predetermined point. This gives the signal at the main office of the company, indicating not only the fact that a frost is imminent but also from which direction it is coming. Following this signal the several orchard men in the affected district are immediately notified by telephone, allowing them time to start fire in the smudge pots with which light or medium frosts can be successfully combated.

All education and all moral discipline should have but one object—to make altruism predominate over egotism.

Items of Personal Interest

Mr. J. W. Flickwer has been appointed foreman of the Santa Fe, at Needles, Cal.

Mr. J. J. Wagner has been appointed foreman of the Santa Fe shops at Clovis, N. M.

Mr. J. D. Williams has been appointed general foreman of the Southern at Athens, Ga.

Mr. A. W. Hall has been appointed roundhouse foreman on the Texas & New Orleans at Eclo, Tex.

Mr. H. A. Prewitt has been appointed general foreman of the Southern Kansas with office at Amarillo, Tex.

Mr. W. P. Hawkins has been appointed fuel agent on the Missouri Pacific System with office at St. Louis, Mo.

Mr. W. D. Blakney has been appointed acting foreman of shops on the Intercolonial at Moncton, N. B.

Mr. R. S. Ramsey has been appointed general foreman of shops on the Oregon Short Line at Pocatello, Idaho.

Mr. Thos. Booth has been appointed general foreman of the Santa Fe, Western Lines, with office at Clovis, N. M.

Mr. F. J. Slider has been appointed shop foreman on the New Orleans, Mobile & Chicago at Louisville, Miss.

Mr. W. W. Wilson has been appointed foreman of the car department on the Chesapeake & Ohio, at Peru, Ind.

Mr. D. T. Green has been appointed signal inspector on the New York Central Lines with office at Albany, N. Y.

Mr. K. Chynoweth has been appointed roundhouse foreman on the Central Vermont at Montpelier Junction, Vt.

Mr. E. M. Wilcox has been appointed general foreman of the Lake Shore & Michigan Southern with office at Englewood, Ill.

Mr. Joseph Maroney has been appointed road foreman of engines on the Pere Marquette, with office at Traverse City, Mich.

Mr. Joseph Goodwin has been appointed road foreman of engines on the Michigan Central with office at Bay City, Mich.

Mr. E. Erikson has been appointed general foreman of the car department on the Chicago, Indiana & Southern at Gibson, Ind.

Mr. W. L. Dross has been appointed master mechanic of the Dayton, Lebanon & Cincinnati with office at Centerville, Ohio.

Mr. J. C. Mill has been appointed signal engineer of the Chicago, Milwaukee & St. Paul with offices at Milwaukee, Wis.

Mr. W. F. Howard has been appointed general foreman of the Gulf, Colorado & Santa Fe with office at Cleburne, Tex.

Mr. W. H. McAmis has been appointed master mechanic of the Charlotte Harbor & Northern, with office at Arcadia, Fla.

Mr. E. F. Davies has been appointed assistant road foreman of engines of the Florida East Coast Railway, with headquarters at Miami, Fla.

Mr. W. T. Cousley has been appointed master car builder of the San Antonio & Aransas Pass Railway with office at San Antonio, Tex.

Mr. C. M. Daly has been appointed foreman locomotive repairs at New Smyrna, Fla., for the Florida East Coast Railway, vice M. M. Ramsey.

Mr. H. C. Van Buskirk has been appointed mechanical superintendent of the St. Paul & Kansas City Short Line with office at Des Moines, Ia.

Mr. G. T. Depue, formerly master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis, at Galion, Ohio, has been appointed shop superintendent at the same place.

Mr. J. H. Watters, assistant master mechanic of the Georgia, has been appointed master car builder with office at Augusta, Ga. Mr. Watters succeeds Mr. John S. Cook, deceased.

C. R. Weaver has been made vice-president of the L. J. Bordo Company, Philadelphia, Pa., succeeding C. W. Allen, resigned. Mr. Allen has also resigned his position as a director of this company.

Mr. E. L. Akans has been appointed general foreman on the Southern at Asheville, N. C., and Mr. J. C. Dunham has been appointed to a similar position on the same road at Charleston, S. C.

Mr. Judson Zimmer has been appointed acting master mechanic of the Fonda, Johnstown & Gloversville Railroad Company, in place of Mr. John Sibbald, who has resigned to engage in other business.

C. H. McCormick, for a number of years connected with the mechanical department of the Michigan Central, has been made district manager of the Standard Heat & Ventilation Co., Inc., New York, with office in Cincinnati, Ohio.

Mr. I. S. Downing, formerly master car builder of the Lake Shore & Michigan Southern at Collinwood, Ohio., has been appointed master car builder of the Cleveland, Cincinnati, Chicago & St. Louis and the Peoria & Eastern, with offices at Indianapolis, Ind.

Mr. Alex. Young has been appointed general foreman of the locomotive department on the Chicago, Milwaukee & St. Paul with office at Chicago, Ill., and Mr. Jos. Badenberger has been appointed road foreman of engines on the same road at Des Moines, Ia.

Mr. J. W. Senger, formerly master car builder of the Lake Shore, at Edgewood, Ill., has been transferred to the Collinwood shops, Cleveland, Ohio, and Mr. George Thompson, formerly assistant car builder at the same place, has been promoted to master car builder, and Mr. James Reed has been appointed assistant master car builder at Englewood.

Mr. W. M. Gimlo has been appointed master mechanic on the Minneapolis & St. Louis with office at Marshalltown, Ia., and Mr. J. R. Gotschall has been appointed road foreman of engines on the same road with office at Watertown, N. D., and Mr. H. J. Henley has been appointed roundhouse foreman on the same road with office at Des Moines, Ia.

We are pleased to announce that Mr. Charles W. Allen has been appointed manager of the railway department of the Reading-Bayonne Castings Company, with headquarters in Reading, Pa. Mr. Allen, who is a past railway master mechanic, has a host of friends in the mechanical railway craft which gives him powerful influence in selling goods for railway use.

Mr. A. D. Wyckoff has been appointed eastern railroad representative of S. F. Bowser & Company, the well known manufacturers of oil storage systems. Mr. Wyckoff has been in the service of the company for a number of years as an efficiency expert is designing equipment for the handling and storage of oils, as well as oil filtering and circulating systems for railroads and manufacturing institutions.

Mr. F. H. Clark, superintendent of motive power of the Baltimore & Ohio, announces the following appointments: Mr. J. W. Adams, assistant superintendent of shops at Mt. Clare, Baltimore, Md.; Mr. W. I. Rowland, motive power inspector at Baltimore; Mr. E. Hinkens, assistant master mechanic at Glenwood, Pa.; Mr. D. H. Watson, assistant master

mechanic at Cumberland, Md. The following are appointed general foremen, locomotive department: Mr. Wm. Battenhouse, at Pittsburgh, Pa.; Mr. W. W. Calder, at Cumberland, Md.; Mr. J. J. Foley, at Weston, W. Va.; Mr. W. F. Foran, at Columbus, Ohio; Mr. F. K. Mores, at Garrett, Ind.; Mr. E. A. Rauschart, at Glenwood, Pittsburgh, Pa.; Mr. J. A. Subject, at Lorain, Ohio.

Mr. Marshal B. Lloyd, president of the Lloyd Manufacturing Company, Menominee, Mich., the inventor of the Lloyd Seamless Steel Tube Mill described elsewhere in our columns, has had a notable career as an inventor. Among his devices are machines for weaving wire fabric, scales and bag-holding machines, steel wheels for light carriages, and numerous other devices. This latest invention, the Seamless Tube Mill, is the result of nearly four years' experimental work, and it is in all likelihood his most important invention. Mr. Lloyd is a native of St. Paul, Minn., and was well known in mechanical engineering, consulting and construction work in Minneapolis, Minn., before establishing the manufacturing works at Menominee, Mich.

MARSHAL B. LLOYD.

Mr. G. W. Wildin, mechanical superintendent, New York, New Haven & Hartford, announces the following changes in his department: Mr. C. J. Stewart, master mechanic of the Boston division, has been appointed assistant mechanical superintendent, with office at New H ven, Conn. Mr. H. C. Oviatt has been appointed superintendent of the Old Colony Division. Mr. G. A. Moriarty, master mechanic of the Providence Division, is appointed master mechanic of the Boston Division, with office at South Boston, Mass. Mr. C. H. Reid, master mechanic of the Western Division, is appointed master mechanic of the Providence Division, with office at Providence, R. I. Mr. F. W. Nelson, general road foreman of engines, is appointed master mechanic of the Western Division, with office at Waterbury, Conn. Mr. J. McCabe is appointed master mechanic of the New York Division, with office at Harlem river, N. Y. Mr. W. E. Ailing, master mechanic of the Old Colony Division, is appointed master mechanic of the Shore Line Division, with office at New Haven. Mr. J. H. Daley, road foreman of engines of the Shore Line Division, is appointed master mechanic of the Old Colony Division, with office at Taunton, Mass.

Mr. G. M. Crownover, who has been appointed superintendent of motive power of the Chicago Great Western, with office at Oelwein Shops, Oelwein, Ia., was formerly shop master mechanic at Oelwein. He graduated from the high school at Hampton, Ia., and entered the service of the Illinois Central at Waterloo in 1881 as machinist apprentice, and served four years, after which he worked two years as journeyman machinist. In 1887 he was transferred to Clinton, Ill., as roundhouse foreman, remaining in this position until April, 1892, at which time he was transferred back to Waterloo, Ia., to take a position as machine shop foreman. In October, 1896, he was promoted to general foreman in charge of the Waterloo shops. In December, 1900, he was transferred to Fort Dodge, Ia., as division foreman, and remained there until April, 1902; then he took a position at Waterloo in charge of the new shops as general foreman. November 20, 1902, he was appointed master mechanic at Freeport, Ill., and on November 15, 1904, was appointed shop superintendent in charge of Burnside shops, Chicago, Ill. On December 20, 1909, he resigned to accept a position as master mechanic for the Chicago Great Western at Oelwein, Ia., and was appointed superintendent of motive power of that road September 1, 1913.

G. M. CROWNOVER.

President Frank P. Roesch.

At the last convention of the Traveling Engineers' Association Mr. Frank P. Roesch, master mechanic, El Paso & Southwestern System, was elected president of the organization, a most worthy choice. Besides being remarkably well informed on everything relating to the design, construction and operation of railway rolling stock and machinery, Mr. Roesch is a good writer on mechanical subjects, many excellent articles from his pen having appeared in our columns.

FRANK P. ROESCH.

An exhaustive biographical sketch of Mr. Roesch appeared in RAILWAY & LOCOMOTIVE ENGINEERING a year ago from which our readers have learned that he was born in Alsace and came to this country with his parents when six years of age. His first railway experience was given through a machinist apprenticeship in the shops of the Rock Island System at Trenton, Mo. We find him at different times working as fireman, locomotive engineer, roundhouse foreman, general foreman, road foreman of engines and master mechanic. Under the instruction of his father, who is an engineering college graduate, he acquired some knowledge of mechanical engineering. There are few master mechanics in the country equally trained with Mr. Roesch for the higher positions in railroad service.

Obituary.

THOMAS WALSH.

In our issue of October, 1908, we published an exhaustive biographical sketch of Thomas Walsh, one of the well known old time locomotive engineers and father of Mr. J. F. Walsh, long superintendent of motive power of the Chesapeake & Ohio. It is now our melancholy duty to record the death of Thomas Walsh in the 83rd year of his age. He was born in Ireland in 1830 and came to this country when he was 19 years old.

RAILROAD NOTES.

The Great Northern is in the market for 25 passenger cars.

The Maine Central, it is reported, will close contracts this week for 15 cars.

The Northern Pacific has ordered 3,000 tons of bridge material from the American Bridge Co.

The Missouri, Kansas & Texas has ordered 7,500 tons of rails from the Pennsylvania Steel Co.

The Southern Pacific has ordered 28,000 tons of rails from the Tennessee Coal, Iron & Railroad Co.

The New York Central Lines will soon be in the market, it is said, for about 125,000 tons of rails.

The Toledo, St. Louis & Western has ordered five locomotives from the Baldwin Locomotive Works.

The Korean Government Railways have ordered 6 Pacific type locomotives from the Baldwin Locomotive Works.

The Lackawanna Steel Co. has booked an order for 5,000 tons of rails for the Manila Railroad, Philippine Islands.

The Delaware & Hudson, it is reported, will expend about $300,000 in improvements to its yards at Carbondale, Pa.

The New York, Chicago & St. Louis has ordered 5,500 tons of Bessemer rails for next year from the Illinois Steel Co.

The Norfolk & Western Railway is erecting a new roundhouse and making other terminal improvements at Columbus, Ohio.

The Philadelphia & Reading, it is reported, has just entered an order for 10 freight locomotives to be built in its own shops.

The Toledo, St. Louis & Western R. R. has ordered five consolidation (2-8-0) locomotives from the Baldwin Locomotive Works.

The Grand Rapids & Indiana has ordered 60 steel gondolas from the Cambria Steel Co., and 85 flat cars from Pressed Steel Car Co.

The Brazil Northeastern has ordered four ten-wheel locomotives and three consolidation locomotives from the Baldwin Locomotive Works.

The Western Pacific Railway has just completed eight new shop buildings at Sacramento, Cal., and contemplates the erection of two more.

The San Antonio, Uvalde & Gulf has ordered two consolidation locomotives and two ten-wheel locomotives from the American Locomotive Co.

The Kansas City Terminal Railway has awarded contract to the Gale Construction Co. to erect a sixteen-stall roundhouse at Kansas City, Mo.

The Chicago, Burlington & Quincy is reported to be in the market for a number of Santa Fe type locomotives and a number of Pacific type locomotives.

The Chicago, Burlington & Quincy Railroad has ordered 15 combination baggage and mail and 10 postal cars from the American Car & Foundry Co.

The Norfolk & Western has ordered 24 electric locomotives from the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Co.

The Norfolk & Western has ordered one 130-ton electric locomotive from the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Co.

The Kansas City Terminal Co. has awarded contract for 700 tons of steel for its proposed power house at Kansas City, Mo., to the Kansas City Structural Steel Co.

The Western Pacific is said to have acquired survey, together with all maps and data that was made about three years ago for a line through Nevada and California.

The Montreal Locomotive Works, Ltd., is making extensions to its shops at Longue Pointe, Montreal, Que., and adding new equipment. The improvements will cost about $600,000.

The New York Central Lines have ordered over 300 passenger cars from the Pressed Steel Car Co., the American Car & Foundry Co., the Pullman Co. and the Standard Steel Car Co.

The Chicago & Western Indiana is in the market for additional switching locomotives. It is said that this company and the Belt Ry. of Chicago are in the market for 10 switching locomotives.

The Pullman Co. has ordered material and specialties for 100 standard steel sleeping cars. Construction of these cars will be begun October 1 and they will be completed before November 1.

The Boston & Maine has ordered 500 30-ton steel underframe box cars from the Keith Car & Manufacturing Co., Sagamore, Mass., and 500 50-ton gondola cars from the Pressed Steel Car Co.

Work will be started this fall, it is said, on shops of the Portland, Eugene & Eastern at Oregon City, Ore. The first buildings will be a concrete foundry and a machine shop at an estimated cost of $90,000.

The Cleveland, Cincinnati, Chicago & St. Louis is said to have plans to build a $30,000 roundhouse at Mt. Carmel, Ill. This road has also begun construction on another roundhouse to be erected at East St. Louis, Ill.

The New York, New Haven & Hartford directors are said to have authorized the expenditure of $365,000 for the immediate extension of the improved signal system which has already been installed over a portion of the road.

The Shreveport & Calcasieu Construction Co. is reported to have taken over the Orange & Northeastern, now building between Orange, Tex., and Natchitoches, La. It is reported that the road will be carried to Shreveport, La., making its total length 204 miles.

The Canadian Pacific Railway has plans for large extensions to be made on the Angus shops at Montreal, Que. The erection of two material shops, passenger car shop, freight car shop, bolt and nut shop and extensions to the locomotive shop is contemplated.

The Baldwin Locomotive Works has booked orders for six Pacific locomotives for the Korean government railways, four ten-wheel locomotives and three consolidation locomotives for the Brazil Northeastern and one consolidation locomotive for the Czarnikow Rionda Co., of New York.

The International & Great Northern has ordered three oil-burning consolidation locomotives from the American Locomotive Co. The dimensions of the cylinders will be 22 in. x 30 in., the diameter of the driving wheels will be 57 in. and the total weight in working order will be 217,000 lbs.

The Gulf, Colorado & Santa Fe is completing arrangements for the construction at Guthrie, Okla., of a water plant, reservoir, etc., to cost about $100,000. This road has awarded contract for an eight-stall brick and concrete engine house to be erected at Silsbee, Tex., to H. D. McCoy, Cleburne, Tex.

Dangers to Trainmen.

The Federal Arbitration Board, which is investigating the demands of trainmen, has been holding sessions in New York. The trainmen are doing their best to make plain the dangerous nature of their occupation.

It was a little surprising to have it stated in the hearing before the Federal Arbitration Board that on American railroads an employee is killed or disabled for life every 7¼ hours and one is injured every nine minutes. It was more surprising to have that statement disputed as an exaggeration.

In the year ended June 30, 1912, according to the reports of the Interstate Commerce Commission, 3,235 railroad employees were killed and 50,079 were injured.

One was therefore killed not every 7¼ hours, but about every three hours; and one was injured not every nine minutes, but every five and a half minutes.

New Haven Trains to Be Operated by Electricity.

The information comes to us as we go to press that the New York, New Haven & Hartford Railroad Company have decided to equip the whole of the road with electricity for operating all passenger trains. The officials of the company have established a press bureau which will supply newspapers with particulars of the work of changing the motive power as it progresses, so we will be able to place before our readers full information about this important work as it proceeds.

Welcoming Visitors.

Railway officials expect to be courteously treated when they call upon any office for business purposes, but some of them treat visitors to their own offices as if they were intruders who deserve no consideration. Realizing this condition of affairs we were struck with admiration on reading a large poster in the hall of the office of the Superintendent of Motive Power of the Chicago, Rock Island & Chicago Railway at Chicago which reads:

VISITORS HAVING OFFICES IN CHICAGO WILL BE RECEIVED DAILY, EXCEPT SATURDAY, BETWEEN 10.30 A. M. and 3.30 P. M. OUT OF TOWN VISITORS WILL BE RECEIVED AT ANY TIME.

Tonsorial artist surveying his victim: "Your hair is getting very thin, sir."

Victim: "Yes. I've been treating it with anti-fat; I never liked stout hair."

Artist: "You really should put something on it."

Victim: "So I do—every morning."

Artist: "May I ask what?"

Victim: "Yes, my hat." (Cutting silence.)

Needed Strong Suction.

Thomas Watson, a big full-blooded man, was a switchman at Forfar station. Having got thoroughly drenched in a rain storm he was laid up with a bad cold which developed into pleurisy. A doctor was sent for who considered the man's condition serious, and provided a supply of leeches to draw the clotted blood from the patient's side.

On calling a day or two later he remarked, "Mrs. Watson, your man's much better. I'm thinking you made good use of the leeches."

"Leeches," sneered Mrs. W., "do you think these worms would help my Tom? Na, Na. I put a ferrit to his side."

The Real Boss.

"Your clerks seem to be in a good humor," remarked the friend of the great merchant.

"Yes," replied the great merchant. "My wife has just been in and it tickles them to death to see somebody boss me around."

During the enginemen's strike on the North British Railway, Tom Lawson, a poor fireman, volunteered to take the place of driver on a passenger train engine. When he tried to stop the train at Leysmill he ran past, and on trying to make the platform a second time again ran past. Nothing daunted Tom was going to make a third attempt when the stationmaster ran up shouting, "Stop where you are Tom and we'll move the station."

Robbie was making a picture, and his mother asked, "What picture are you making my son?" "A picture of God," was the reply. "Why, my boy," said the mother, "no one knows how God looks." "Well let them wait till I'm done and then they'll know."

Could Not Reduce That Congregation.

A chaplain recently appointed to a prison in New York State entered upon his duties last month. In taking part in a round of inspection he displayed much pomposity towards the prisoners. To one prisoner he asked one law-breaking friend: "Do you know me?"

"No," replied the prisoner. "I don't know you and have no wish for better acquaintance."

"Well, I'm your new chaplain."

"The hell you are. I know all about you."

"What do you know about me?"

"I know that you are what the Scots call a stickit-minister, that you have preached three churches empty and have got this appointment because it is impossible for you to reduce the congregation."

Milwaukee Way.

A teacher in a Milwaukee school was trying to instruct her pupils on the meaning of "introduction." Tommy Bryan was a bright boy and teacher thought she could get him to make the expression clear.

"Does your mother ever have callers, Tommy?"

"Yes'm."

"Well, now, suppose that two ladies came to call on your mother. Your mother knows one of the ladies, but not the other. How would she become acquainted with this lady?"

"She'd send me out for a can of beer."

Mixed Metaphor.

"Uncle Pete, why don't you get married?" "Why, you see, sah, I got an old mudder, an' I hab to do for her; yet see, sah, an' if I don't buy her shoes an' stockings she wouldn't get none. Now, if I was to get married, I would hab to buy dem tings for my wife, and dat would be taking de shoes an' stockings right oot of me mudder's mouf."

Gravitation Frozen.

An American and Scotsman were discussing the cold experienced in winter in the north of Scotland.

"Why, it's nothing at all compared to the cold weather we have in the States," said the American. "I can recollect one winter when a sheep jumping from a hillock into a field, became suddenly frozen on the way and stuck in the air like a mass of ice."

"But, man," exclaimed the Scotsman, "the law of gravity wouldn't allow that."

"I know that," replied the tale pitcher. "But the law of gravity was frozen, too!"

A new curate paid his first visit to the infant school. "Now, my dear little children," he said, "I don't suppose any of you have seen me before, have you?" The majority of the children answered, "No sir," but one knowing little fellow held up his hand till he gained the eye of his teacher. Asked what he wanted, the boy replied, "please, teacher, I seed him out with his gal last night."

The celebrated soprano was in the middle of her solo when little Johnny said to his mother, referring to the conductor of the orchestra: "Why does that man hit at the woman with his stick?"

"He is not hitting at her. Keep quiet."

"Well, what is she hollerin' so for?"

The most impressive thought inspired by the Great Columbian Exposition was the reflection that the vast Machinery Hall, if locked up for fifty years, might be valued only as a museum of antiquities.

Nature's Method of Working.

Silence marks the working of the greatest forces of life, although people who hear the roar and rattle of elevated trains would hardly believe that. None hears the sun draw up into the sky the countless tons of water that fall in rain showers. No person hears the groaning of the oak's fibres as it grows to its strength and height. Noise is usually an after effect and does not accompany initial power. Sounding brass and tinkling cymbal are noisy but not powerful. So the will reaches its decisions in silence, and it does not need much shouting to know when a person is in earnest. We need not become anxious when our sincerest work produces no great commotion, nor any startling effect. If we are really in earnest let us do what we can without unnecessary noise. The noisy workman illustrates the truth of the saying of the man who was shearing a pig. "Much cry and little wool."

Safety at Railroad Crossings.

An illuminated poster of durable cardboard has been issued by the Pennsylvania Railroad system and conspicuously placed at all of the 13,027 crossings at grade in the company's lines. It contains an earnest appeal to the public, particularly every driver of a vehicle to "Stop, Look and Listen," before crossing a railroad track. The crossings are being removed as rapidly as possible, but at an average cost of $50,000 for the removal of each, it will be many years before the last of them are seen. Meanwhile the general public should assist in saving themselves. Human lives are the most precious things in the world.

Geo. M. Basford, chief engineer of the Joseph T. Ryerson & Son, has accepted appointment as a member of the general executive committee of the Railway Business Association. Mr. Basford in the early months of the association, while assistant to the president of the American Locomotive Company, served for a time as acting secretary of the organization, and has since kept in close touch with its work.

Where He Blundered.

Attorney John J. Sullivan tells a story about a Milesian wielder of the pick who had been digging a trench for a gas pipe leading to a private residence—a 1-inch pipe.

Contemplating the excavation and comparing its capacity with the loose dirt he shook his head in doubt. "Be this and be that," said he, "I'm thinking I'll not have room in the ditch for awl the dirrt on the pile, bad 'cess."

"But," said a bystander, "why not, Pat?"

"Sure," he made reply, "because I didn't dig it deep enough!"

Books, Bulletins, Catalogues, Etc.

Baldwin's Forty-Thousandth Locomotive.

A memorial volume commemorating the building of the forty-thousandth locomotive by the Baldwin Locomotive Works has just been issued and is in itself an admirable example of the printer's art. The locomotive so fittingly commemorated is one of thirty similar engines built for the Pennsylvania Lines West, and is of the "Pacific" type, intended for heavy passenger service. The locomotive is equipped with all of the modern improvements and weighs 293,000 pounds. The cylinders are 26 inches by 26 inches, the driving wheels 80 inches in diameter and the tractive power 38,300 pounds. The locomotive is equipped with the Crawford stoker. Two fine illustrations of the locomotive are given, but the chief value of the elegant memorial volume is in the highly interesting history of the Baldwin works during the eighty-two years of continuous operation. In a large sense it is the history of the development of the locomotive in America. Ten types of locomotives illustrate the development. There are also an equal number of views of the company's various works, so that the volume altogether is a rich addition to the railroad literature of our time, especially in regard to the history of the development of the locomotive in America.

McRae's Blue Book.

Among the variety of publications that annually appear with a view to facilitate the various trade supply department traffic, few indeed are worthy of any particular comment. MacRae's Blue Book, a standard index of railway supply manufacturers and their products, has risen to the dignity of an institution. Extending to nearly 800 pages it furnishes a complete list of the manufacturers of railway material and supplies, arranged alphabetically, and giving addresses of both home and branch offices. The arrangement is at once complete and exact. Every article used in the construction and maintenance of steam and electric railways is given and the names and addresses of the manufacturers thereof. A valuable addition is the standard list prices of material commonly purchased by railways, and a large and valuable mass of miscellaneous data of particular interest to the purchasing, mechanical and engineering departments, including tables, rules, weights and measurements. To purchasing agents and other officials connected with the specifying of railway material the book is furnished without cost. To others the price is ten dollars. It is well worth the money, and its increase in bulk year by year is the best proof of its growing popularity.

Proceedings of the Fifth Annual Convention of International Railway Fuel Association.

This very handsome report of 330 pages, edited by Secretary C. G. Hall, McCormick Building, Chicago, contains as much interesting and valuable reading matter for railroad mechanical men as any volume we have recently examined. It is only a short time since no more attention was paid to the quality of coal purchased for railroad use than there was to the quality of ballast, but matters have been radically changed in that respect and most railroad companies now require to know the quantity of heat producing elements in coal, a desirable change that has been promoted in a marked degree by the efforts of the International Railway Fuel Association. This volume reflects the work of the Association in identifying the quality of fuel and also work done in making fuel more efficient and as showing the effect or scale on heating surfaces. The handling of fuel received much practicable attention and there was an admirable report on Firing Practice which ought to be in the hands of every fireman whose duty it is to keep a locomotive boiler "hot." It is really the best treatise on firing we have ever read. Self-Propelled Railway Passenger Cars is the subject of a good report and the motive power for such cars is exhaustively described This brief notice fails to do justice to the admirable Annual Report and we commend its study to all the people likely to be interested.

Safety First.

The McGraw-Hill Book Company, New York, has issued an illustrated handbook extending to 130 pages by George Bradshaw, Safety Engineer, and author of "Prevention of Railroad Accidents." The purpose of the book is tersely set forth as "First Aid to the Uninjured." Surely if it is easier to keep well than to make well, the perusal of this book cannot fail to impress every railroad man with the necessity of trying to prevent accidents. Views of unsafe and safe practices are given. There are condensed experiences. It is amazing to follow some of the little incidents that lead to solemn tragedies in railroad life, and the thought is brought clearly home in Mr. Bradshaw's pages that a little more attention would have saved thousands of valuable lives. An admirable feature of the book is the brevity with which the subjects are treated. A glimpse, a hint, and the road to the cemetery or the road to safety opens up like a moving panorama. The price of the book is fifty cents, and its wide circulation among railroad men would be an educational advantage of surpassing effect.

Bell Ringers.

Mr. H. G. Hammett, of Troy, N. Y., is a quiet, thoughtful, earnest engineer. You rarely hear him speak, but the Trojan bell ringer speaks for him. He has just issued an illustrated Bulletin, showing the details of the bell ringer. It is a clever device, conceived in ingenuity and perfected by experience. It is generally conceded to be the most durable, simple, efficient and economical contrivance of the kind yet placed on the market. The use of bell ringers is almost universal and in some States is imperative. Engineers and firemen have enough to do without ringing bells. At a moderate cost Hammett's bell ringer will do it for them. Send for a copy of the Bulletin to the main office at Troy, N. Y.

Switching Locomotives.

Bulletin No. 1015, just issued by the American Locomotive Company, is more than usually interesting for the fact that it presents in a condensed and interesting form the details in regard to modern switching locomotives. That the service performed by switchers at the present day is remarkable when taken into comparison with the kind of service performed only a few years ago, is well known to all familiar with railroad details. It is recognized that as the road engine increases in size it becomes relatively important to provide means at the terminals whereby the heavy trains may be economically handled. In this regard the new Bulletin presents an array of facts that convey a mass of information in regard to the growing capacity of the modern switchers. Twenty-four illustrations are given showing switchers with six, eight or ten drivers, many of them having the tractive power of the heavy road engines, and in many cases embodying superheaters and brick arches, and some of them also including power reverse gears. Their tractive power ranges from 23,800 pounds to 55,350 pounds.

The Whole "Kewanee" Family.

An illuminated catalogue of 50 pages, embracing all "Kewanee" specialties manufactured at Kewanee Works, is just issued by the National Tube Company, Pittsburgh, Pa. The Kewanee Works are located at Kewanee, Ill., where steam-heating boilers, radiators, etc., are made. The work is distinguished by many new and important devices, especially the unions used in pipe work. The union of brass and iron ground ball joints which was introduced by the company is the most durable of all joints, and in close quarters no other kind of joint is reliable. The joints are carefully ground and tested and no gaskets are necessary, the joint being really the most durable part of the structure. Flange unions are handled in the same way. Brass cocks, check valves, globe and angle valves are also among the company's products, and all have stood the test of time and high pressure and are absolutely reliable. Send for a copy of the catalogue to the National Tube Company's main office, Frick Building, Pittsburgh, Pa.

Armspear Lamp.

The Armspear Manufacturing Company, New York, has issued a colored Bulletin No. 15, illustrative of the Armspear Spheroidal Lens Lamps. These lamps have made it possible to procure an effective long range of slightly less intensity than the concentrated light given from the smooth-face lens, but performing all the functions of the present lamps, and, in addition, a divergent light is provided, covering an area of 90 degrees from each section. The value of this lamp and its wide range of illumination, especially at curves, cannot be overestimated. Semaphore, switch, engine, marker and tail lamps have all been greatly improved upon since the introduction of the Armspear devices. Send for a copy of the Bulletin to the company's office at 451 West 53rd street, New York.

Electric Light for Railway Cars.

The United States Light & Heating Company has issued a Bulletin No. 207, illustrating and describing axle equipments, a system which has been very successful in making each car a distinct lighting unit with it own source of electric energy derived solely from the movement of the car and independent alike of specially equipped locomotives or trains and battery charging systems. The factory is located at Niagara Falls. In one of the laboratories complete equipments may be seen operating under all conditions of load and speed so as to demonstrate how the equipments meet these conditions and produce perfect illuminations. The various types of generators and methods of suspension are shown in the Bulletin. The battery and battery boxes are also shown and the complete equipment fully explained. Copies of the Bulletin may be had on application at the company's general office, 30 Church street, New York.

The office of the Goldschmidt Thermit Company in San Francisco, Cal., has been removed from 432-436 Folsom street to 329-333 Folsom street.

Never shut the door upon any one so fast that it cannot be opened from the outside.

Tell me how much one is given to fear, and I will tell you how much he lacks in faith.

WANTED

We desire to purchase complete volumes of RAILWAY & LOCOMOTIVE ENGINEERING for the years of 1905 and 1906.

Copies may be either bound or unbound. In writing give full particulars as to condition, etc.

ANGUS SINCLAIR CO.,
114 Liberty St., New York, N. Y.

Railway and Locomotive Engineering

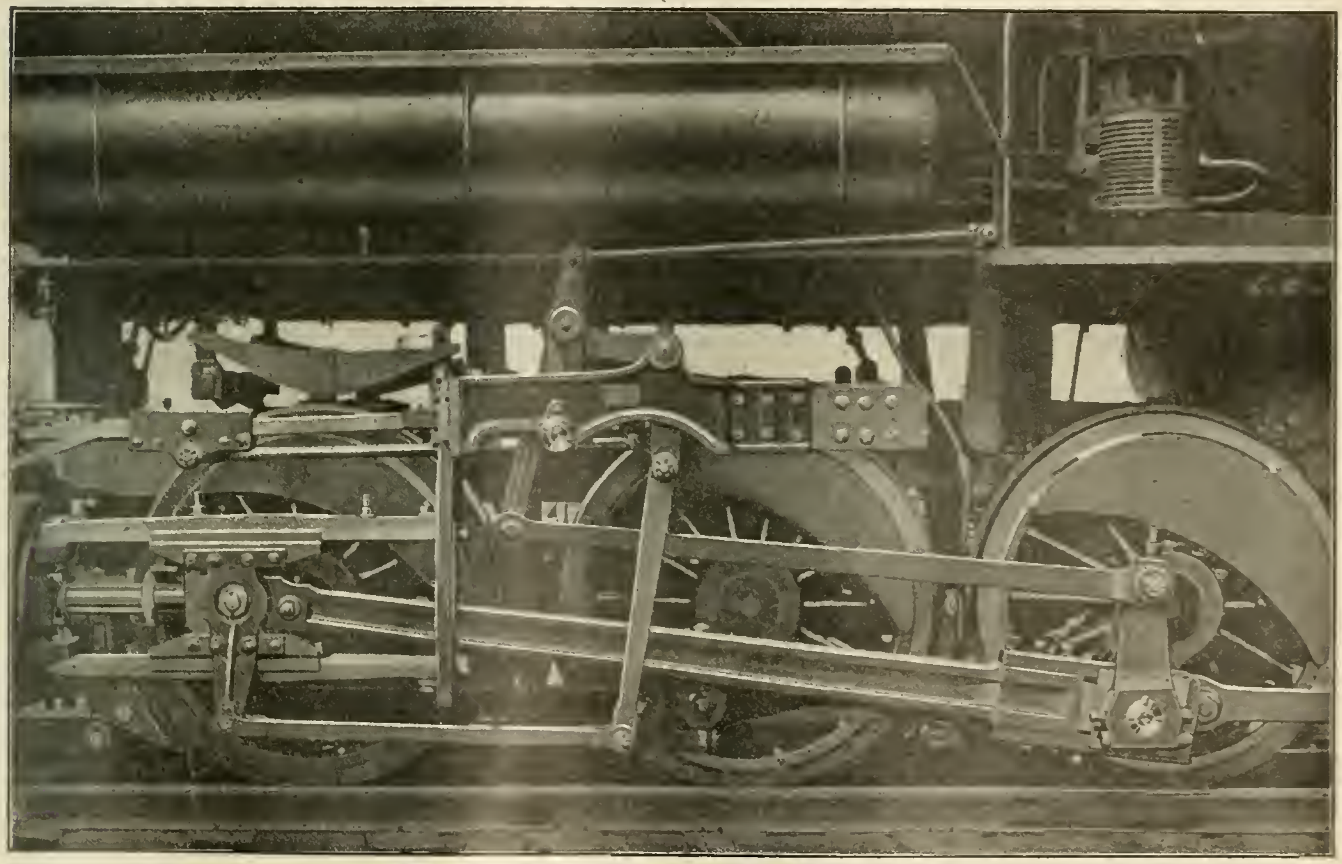
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVI. 114 Liberty Street, New York, November, 1913. No. 11

The Baker Locomotive Valve Gear

The increased popular favor with which the Baker Locomotive Valve Gear is being received among railroad men wherever its merits have had the opportunity of becoming thoroughly known, and the many inquiries that have come to us regarding the details of its mechanism, induces us to give more than a mere passing notice to its construction and adjustment. Like the Walschaerts valve gear, its arrangement outside of the locomotive frames meets a necessity in the twentieth century locomotives where the limited space between the frames with the increasing size of axles and eccentrics has rendered it particularly difficult to adjust or examine the Stephenson valve gearing.

It will be readily observed that the device resembles the Walschaerts valve gearing in two important particulars. The eccentric crank, which gives the valve its motion, is attached to the main crank pin. A combination lever deriving its motion from the crosshead gives the valve its position in relation to the steam ports. The important variation between the Baker valve gearing and the Walschaerts valve gearing consists in the absence of a radial link, whether shifting or fixed. As is well known, the link motion on any form or method of application is a source of error in all valve motions on account of the slipping of the link-block, and is more noticeable in the case of the shifting link, as in general construction when applied to locomotives it travels through a longer extended arc than is usual in the case of links, oscillating, as in the Walschaerts gearing, on a fixed center. Other valve gearings have overcome this drawback, notably that of the Corliss valve gear, but the delicate mechanism of that gearing render its application to locomotive service impractical.



THE BAKER LOCOMOTIVE VALVE GEAR. OUTSIDE ADMISSION.

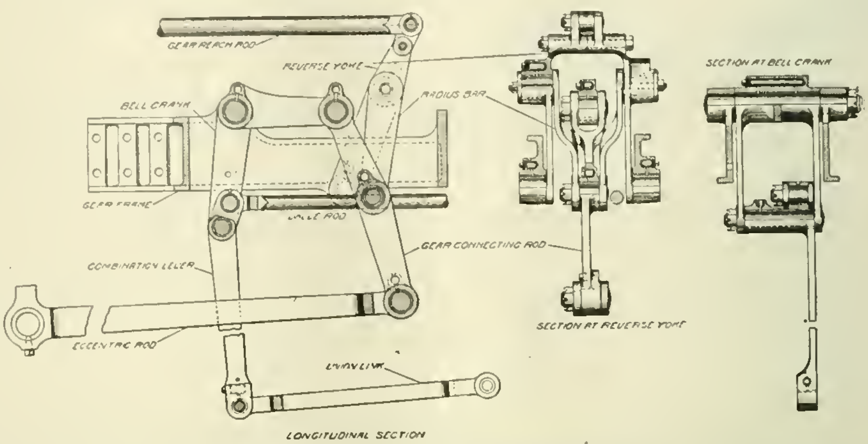
In view of these facts it will be readily understood that if the motion of a sliding valve can be perfectly controlled and the length of stroke varied without the intervention of a radial link, a real gain in the use of steam is made. Not only so, but the valve gearing in locomotive service that readily lends itself to rigidity of movement and at the same time

possesses that flexibility of adaptation essential to the variable requirements of the service is all that can be hoped for, and these qualities are in an eminent degree the leading features of the Baker valve gear.

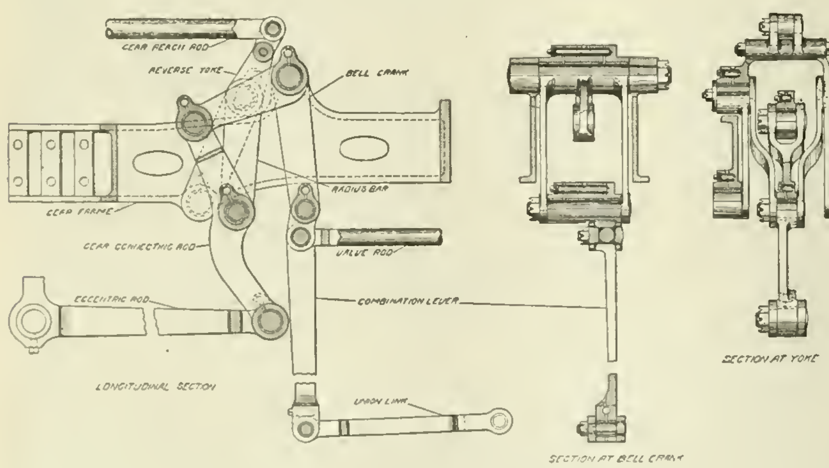
In regard to the various parts of the valve gearing it will be observed that the circular movement of the eccentric crank will impart an irregular linear movement to the eccentric rod, as also does the crosshead impart a similar varying movement to the combination lever. The crosshead travels with an increasing degree of rapidity towards the center of the stroke and diminishes in velocity towards the end of the stroke. The same remarks apply to the eccentric rod. The crosshead movement is at the swiftest point when the eccentric crank motion is at the slowest, because they are set at right angles to each other. The union link attached to the crosshead, and the eccentric rod are connected to separate ends of a bell crank. The end of the bell crank attached to the eccentric rod describes an ellipse at an irregular velocity. This varying motion is conveyed through the bell crank to the combination lever and valve rod as shown in the detailed drawings. The result of the two motions is that the valve travels very rapidly at the beginning of its stroke, and by the time that the piston has moved one-twentieth of its stroke the valve is wide open and the valve then moves very slowly during the period when the piston is moving with increasing rapadity. As the piston approaches the release point the valve again travels with increasing rapidity and closes at its highest speed.

The reversing movement is effected by the eccentric rod being attached to a reverse yoke, and when the reach rod is moved backward or forward it changes the position of the bell crank and affects the position and movement of the valve with a degree of accuracy not obtainable in any motion passing through a shifting or oscillating link. The rods and bell crank are so connected and adjusted that the placing of the reverse lever on any position affects the position of the bell crank conveying a corresponding movement on the valve rod and valve.

The number of joints in all kinds of valve gearing are one of the sources of the irregularities incident to the motion. This is the chief drawback in the shifting link motion, and not only are the joints much fewer in number in the Baker valve gear, but the parts lend themselves readily to massiveness and rigidity of construction which is impossible in the case of the shifting link, and is only partially possible in the case of the Walschaerts valve gearing.



DETAILS OF OUTSIDE ADMISSION.



DETAILS OF OUTSIDE ADMISSION.

In the Baker valve gear the lead or opening of the valve at the end of the piston stroke is an unvarying or constant quantity, so that the length of the valve stroke or point of cut-off of steam supply does not in any way affect the exact amount of opening at the beginning of each piston stroke. Not only so, but the squareness of the events in both motions has a degree of exactness hitherto unapproached in locomotive service.

In the matter of repairs, new bushings may be renewed with ease and rapidity that is at once simple and complete. The interchangeability of the parts have proved themselves that the most advanced methods have been used in obtaining perfection in the duplication of all of the parts comprising the Baker valve gearing.

A particular advantage in running a locomotive with the Baker valve gear is the perfect ease with which the reverse lever may be moved. The lever does not act against any direct thrust of the moving parts, but the reach rod and reverse yoke acting as a lever and fulcrum moves the bell crank readily and easily.

In regard to the adjustment of the gearing, it may be stated that the eccentric rod is the only part that may occasion a renewal of adjustment on account of the incidental wear of the bearings. Increasing or diminishing the amount of lead may be effected by lengthening or shortening the lower arm of the bell crank. The lengthening or shortening of the combination lever also affects the stroke of the valve and consequently the amount of opening the valve.

Steel Passenger Equipment Increasing.

In connection with pending legislation in Congress requiring the replacement of wooden passenger equipment with steel equipment inquiries have been made of all railways engaged in interstate commerce in the United States as to progress in the construction of steel and steel-underframe cars. Replies from 247 companies, operating a total of 252,472 miles of line, show that between January 1 and July 1, 1913, orders were placed for 1,064 steel cars and 76 steel-underframe cars, a total of 1,140. In the four years preceding January 1, 1913, the number of steel passenger cars in service increased from 629 to 7,271, while the number of steel under-frame cars increased from 673 to 3,296. The cost of replacing with steel cars all the wooden cars used in passenger trains is estimated at over $600,000,000.

Improvements on the Lake Shore and Michigan Southern

Since coming under the control of the New York Central system, the Lake Shore and Michigan Southern Railway Company has rapidly developed into one of the best equipped railways in America. Besides the main line extending from Buffalo, N. Y., along the southern shore of Lake Erie to Toledo, Ohio, 294 miles, and from Toledo to Chicago, Ill., by the route touching Adrian, Mich., 244 miles, making a total of 538 miles, there are over twenty other shorter lines of roads owned or leased by the company, and which altogether extend to 1,863 miles in operation, with 975 locomotives and 6,798 cars in service, and traversing half a dozen of the richest states in the country between Pittsburgh, Pa., and St. Louis, Mo., in the southern boundary and Buffalo and Chicago in the northern territory with extensions covering the southern portions of the Michigan peninsula. Of the single track mileage there is not much more than 500 miles now in operation, recent reports showing that there are of second track 614 miles, third track 360 miles, and fourth track nearly 250 miles. Of sidings there are a total of nearly 1,200 miles, so that the total track amounts to 4,280 miles.

VIEW OF THE LAKE SHORE & MICHIGAN SOUTHERN RAILROAD AT SPRINGFIELD, PA. SHOWING FOUR-TRACK WATER TANKS.

In the congested traffic districts the track improvements are being rapidly extended, care being taken that the improvements are keeping pace with each other, the object lessons that are being given in some parts of the country showing clearly that the increase in the weight of motive power and rolling stock should have its counterbalancing equivalent not only in the increased stability of the track but in the number of tracks and especially in the signal equipment. In recent years it has seemed to be the policy of the company to advance track improvements and to perfect the maintenance of way department rather than to encourage a spirit of false economy in running the heaviest kind of motive power and rolling stock over roads that may have been sufficiently stable to endure the traffic of the last century, but are hardly safe under the growing demands of the present day.

The mechanical department, however, has been kept in the front rank of thorough equipment, the various shops at the division points, especially at Collinwood, Ohio, and Elkhart, Indiana, being models of their kind, the Collinwood shop being among the two or three largest rairoad repair shops in America, and having the reputation of being the first railroad shop where what is known as the grouping system of tools and other accessories, whereby the complete repairing of the various parts of the locomotives and other appliances could be completed without the necessity of transferring the parts from place to place. Under this admirable system records have been made and maintained of the complete general repairing of locomotives, including renewal of flues and fire box repairs, of nine or ten days' time in the shops. The same system has more recently been successfully established in the extensive new repair shops of the Delaware, Lackawanna & Western Railroad at Scranton, Pa., but we have not heard of the records of repairs having been surpassed either in completeness of detail or brevity of time taken up in repair, when compared with the regular schedules in vogue at the Collinwood shops.

Of the history of the enterprising railroad company it may be stated briefly that it was chartered August 16, 1869. The proprietary roads were acquired from time to time by the consolidated company, the original incorporation consisting of the Michigan Southern & Northern Indiana, the Cleveland & Toledo, the Cleveland, Painesville & Ashtabula, and also the Buffalo & Erie Railroad Company. A number of other railroads have become incorporated with the consolidated companies since, among the latest being the Detroit, Toledo & Milwaukee Railroad, and the Battle Creek & Sturgis Railroad, formerly leased, became proprietary roads in 1910. In conjunction with the Pennsylvania company, the Lake Shore & Michigan Southern also became joint proprietors of the Lake Erie & Pittsburgh Railway in 1911, so that both companies have equal rights for the operation of their trains over the tracks of that railway.

General Correspondence

Strength of Timber.

EDITOR:

In the September issue of RAILWAY AND LOCOMOTIVE ENGINEERING an anxious inquirer was desirous of knowing the kind of timber that would sustain the heaviest load. For his information it may be stated teak is generally acknowledged to be the strongest kind of timber. A piece of teak 12 inches in length, and 1 inch square, supported at the ends and loaded in the middle will sustain a weight of 800 pounds. Ash will bear about 675 pounds, and English oak or beech 650 pounds. These are the strongest kinds of timber, but the strength of timber varies within wide limits. It differs with the age of the tree, the conditions of growth, the part of the tree from which the piece to be tested is cut, and the amount of seasoning the timber has received. The strength given are fair selected averages, as given by the best authorities, and are as nearly correct as such estimates usually are. In calculating strength of timber structures, a large factor of safety should be allowed.

J. MUIR.

Hoboken, N. J.

Old Valve Gear Made New by Patent.

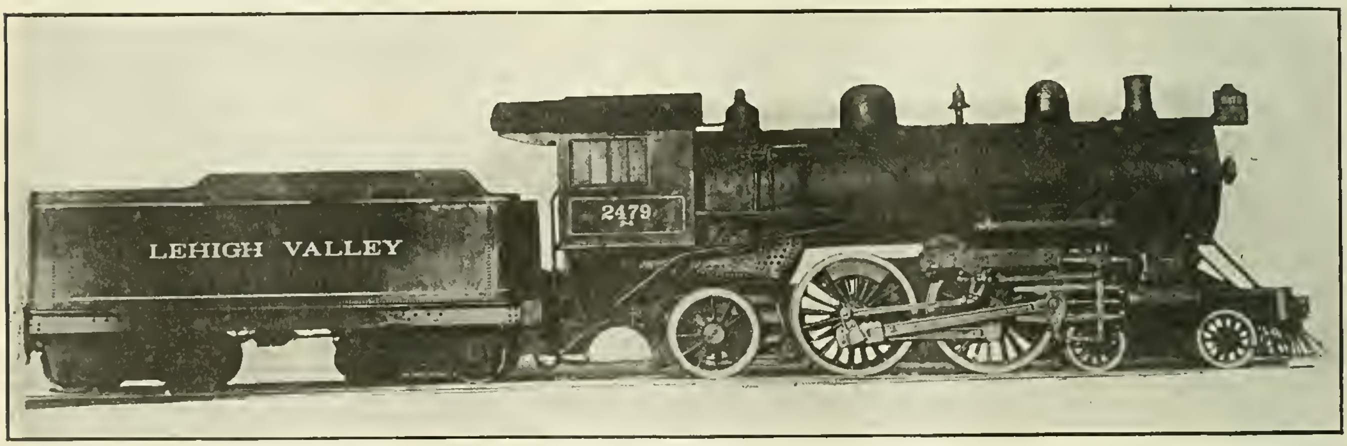
EDITOR:

I write you for information about the valve gear shown on page 345 of the October issue of your paper. With my "old fogy" notions and poor memory, would like to learn what real difference there is between the gear shown and the "Lewis valve motion" which appeared in the early nineties and was from Missouri (St. Louis). They were tried on the Vandalia, and also on the Alton & St. Louis. showing wonderful economy. The one on the Alton was there during our old friend's, Johann's, connection with that road. I never was very much on the new fangled valve gears, but there appears to be a "mania" in the air these days to invent something to make builders of the old shifting link feel like thirty cents, but there are some of them yet running. Many think anything different from old standards must be new and useful. Therefore, they get a patent and are happy for a time.

ANCIENT.

Boston, Mass.

[Our correspondent appears to be correct in thinking that the Young Valve Gear, illustrated on page 345 of our October issue, is the same invention that made some stir twenty years ago under the name of the Lewis Valve Motion. Both are certainly modifications of the Walschaerts Gear.—ED.]



LEHIGH VALLEY TYPE OF ATLANTIC 4-4-2 LOCOMOTIVE.

Inferior Coal Causes Smoke.

EDITOR:

In last month's RAILWAY AND LOCOMOTIVE ENGINEERING, I read another article on preventing smoke on locomotives; I have also seen many devices proposed for remedying the evil. I have had some experience with burning fuel on locomotive engines, and have seen black smoke come from the stacks of coal-burners and clouds of white smoke from the stacks of wood-burners—and it was not caused by water from the boiler; but from the sap in green wood.

I was called up one day by the general manager and asked if I knew anyone who had a knowledge of minerals, more especially coal. When I said I knew a little about coal, anthracite and bituminous, he said: "I don't want you in it. I found a man to fit." I was ordered to have 500 or 600 pounds, or more, taken from the supply on coal platforms, and have the man go through it, and separate the coal from bone slate. I gave the man about 800 pounds, and he went through it, and made two separate lots of about equal size and weight. His report was that one pile would burn, and the other would not. I sent the man's report to my superior, who sent it to the coal company. In a short time the coal company's expert showed up, and made a thorough examination of the condemned pile, and picked out two chunks that he thought would burn. He tried them in a furnace for an hour or more and took them out as free from burn signs almost as the "Men in the Fiery Furnace." The company changed their place for buying coal.

If pure coal or other fuel were to be used under steam boilers of all kinds, it would go very far towards eliminating the smoke evil.

E. J. RAUCH.

New York, N. Y.

Locomotive's Remarkable Record.

BY JOHN DUFFY.

A remarkable record made by one of its crack locomotives has just been compiled by the mechanical department of the Lehigh Valley Railroad. After traveling continuously for a distance, which, if it had been in a straight line on the earth's equator, would have carried it around the globe ten times, in a space of twenty-eight months. without a real breakdown or having to undergo serious repairs, Locomotive No. 2479 has been given a rest and sent to the railroad shops at Sayre, Pa., for a general overhauling.

But the distance it traveled and the time elapsed without needing important

repairs are not the only interesting features in the record of the locomotive, which is an Atlantic type, known as the F-6 class. During the whole of its twenty-eight months when it traveled 245,675 miles, it consumed but 7,748 tons of coal, or an average of but 63.07 pounds of coal per mile run. And all the while it was hauling a seven-car passenger train weighing about 450 tons between Buffalo, N. Y., and Sayre, Pa., a distance of 176.6 miles.

No. 2479 was designed by the mechanical department of the Lehigh Valley Railroad. Its principal dimensions are: Cylinders, 21 in. x 26 in.; diameter drivers (over tires) 77 in.; boiler pressure, 200 pounds; tractive power, 25,310 pounds; total weight of engine and tender, 303,100 pounds; weight on drivers, 105,000 pounds; firebox, semi-wide; flues, 16 ft. 2 in. long; grate area, 51.2 sq. ft.; heating surface, flues, 3,164 sq. ft.; heating surface, firebox, 160 sq. ft.; heating surface, total, 3,224 sq: ft.

Aside from its remarkable fuel performance, No. 2479 made other notable records. During the whole of the twenty-eight months there were but eight machinery failures noted, or, in other words, it traveled 30,709.39 miles to each failure While the locomotive received all the usual care and attention given to all passenger locomotives, no special effort was made to keep down the cost of the incidental minor repairs occasionally necessary upon this particular engine. Including the cost of material and labor during the twenty-eight months of its service, $9,067.26 was spent on it, or less than four cents per mile run. When the locomotive went to the Sayre shops only one of its original set of 374 flues had been removed.

No. 2479 is a sister locomotive to No. 2475, of the Lehigh Valley's service, which made a record run from Buffalo to Jersey City shortly after it was put in service. It covered the entire 446.6 miles in eleven hours and fifty-seven minutes. With the time for thirty-one stops deducted its actual running time was ten hours and forty minutes. For 359 miles it hauled a ten-car train, eleven miles an eight-car train, and the balance of the distance with but seven cars behind it. The total amount of coal consumed on this trip was fifteen tons and seventy pounds, or 67.33 pounds per mile or less than five shovels full per mile. During the run the average steam pressure was 195 pounds.

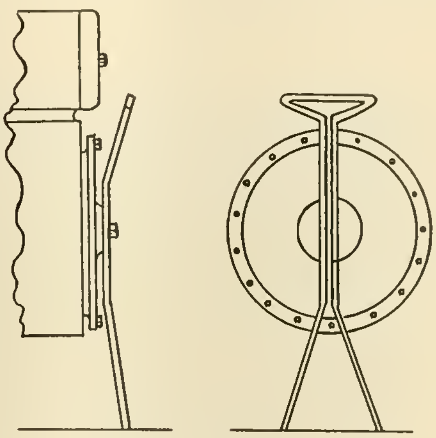
Jig for Use in Handling Heavy Locomotive Cylinder Heads.

By F. W. Bentley, Jr., Machinist.
Butler Shops, C. & N. W. Ry. Co., Milwaukee, Wisconsin.

Large locomotive cylinder heads are an unwieldy part to handle while applying or removing them, and more especially is the above so in the roundhouse during the routine of hurried running repairs. The enclosed sketches are descriptive of a simple jig by means of which the head can be easily and safely removed and applied.

The device is bolted to the head by means of the casing stud before all of the head studs nuts are removed. The head is then easily swung back from the cylinder and leaned against its side or against the pilot beam.

A cylinder head handled in the above manner is always easy to apply and remove, no matter how heavy, and needs not to be handled, which is a commendable feature in the case of hurried roundhouse work. The workman is always back of the head and out of danger, the heavy casting balancing itself in the middle of the jig forks, which may be made of 1 inch or 1¼ inches, square or over, the height and other dimensions to suit.



CYLINDER HEAD HOLDER.

Mismanagement on Railroads.

Editor:

In the Philadelphia *Public Ledger* there was an article on the causes of railroad wrecks which stated that the rails on account of the greater number of wheels on locomotives and cars and the additional weight carried, endured many more blows. True enough, and an extra vibration and the consequently much greater crystalization taking place, it is only a question of time until the rail breaks. Steel makers are often blamed when really the cause is as before mentioned.

If ever there was a time for the traveling public to be in doubt as to their safety, it will be from now on, for the rails have only been increased 25 to 30 per cent., whereas the rolling stock has been increased considerably over 100 per cent. in the same period.

Should not legislative steps be taken to prevent such gigantic rolling stock being used on the tracks and road beds of the present time? Of course, the carrying of more freight with less expense is an incentive for the increasing weight in rolling stock, but the question is—does it not seem a poor way to economize? Is the carrying of more freight a safe proposition when the draw bars on cars are in most cases the same as used for the lighter rolling stock and not prepared to take care of the extra pull from so many and heavy cars linked together? It is a noticeable fact that cars often do sever their connections on these long trains and are the cause of wrecks. So too are they liable to buckle, and nothing has been said about the bridges menaced by this weight, since they were only constructed for the lighter rolling stock. To be on a safe basis, all the draw bar couplings should be renewed, and the bridges reinforced, all items of expense to be added to the list.

The general trend is for efficiency in all directions, but evidently it has not become effective efficiency in this direction, inasmuch as constant immaterial changes are being made in the engines and boilers, which neither greatly increase nor decrease the proved efficiency; else why should many hundreds of locomotives of every class be laid aside yearly for lack of repairs mostly needed on the boilers, and new ones purchased continually to replace those alleged to be defective? Perhaps these minor changes look convincing to railroad presidents and their boards of directors whose attention is demanded by too many things, and who consequently sanction appropriations for new engines; but to engineers their reasons are more or less of a conundrum.

When Mr. Brandeis made his statement that the railroads wasted one million per day in poor management he was laughed at, but it can now be seen and has been announced through the press that strict attention to car service during the last six months of the fiscal year has saved such an immense amount that it looks as though he had a very fair knowledge on the subject after all. So much for one statement of outside brains, it is not to be doubted but that they would laugh again if the statement (that another million per day could be saved in the management of motive power repairs and in coal) was made by those thoroughly conversant with management and mechanical construction. At once it will be seen how a saving of this kind would affect the freighting for which these ponderous locomotives are built.

The Lehigh Valley makes the statement that 10 per cent. saving in coal would mean $1,000 per day to them, yet an actual saving of 5.37 per cent in coal and a gain of 7.77 per cent. in locomotive efficiency, under 14 pounds less boiler pressure, also two-thirds less repairs was not considered worth even honorable mention by a much larger road. Too many subterfuge patents are taken out by those interested in the railways, and which are of no practical use other than to increase the incomes of those directly in-

terested. The above mentioned case of real practical value happened to be from an outsider and of course the saving was of no account since conflicting interests stepped in, even though the actual saving was shown on their own records.

Either the salaries paid to most of the employees of the railroads are not large enough for them to center their entire attention on the good of the road, or else they live faster than a fair income permits, and these subterfuges in the shape of useless patents are fostered.

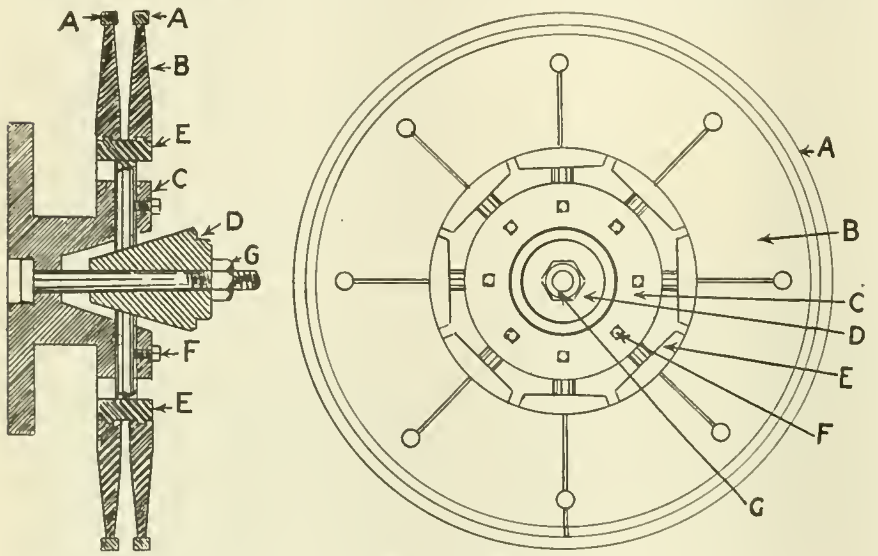
J. B. Freeman.

Philadelphia, Pa.

Device for Turning Piston Rings.

By J. G. Koppell, Montreal, Canada.

The accompanying drawing shows a turning device for locomotive piston rings. The appliance is so constructed and the parts so arranged that two



DEVICE FOR TURNING PISTON RINGS.

piston rings may be turned at the same time.

The letters marked on the drawing refer to the various parts of the device and rings. A, A are the piston rings in position to be turned. B is the expansion ring which is interchangeable with other rings of larger or smaller diameters, according to the size that the rings may require to be turned. C is the main body to which the other parts are attracted. D is the cone for expanding the adjustable expanders marked E, E. F is a set-screw used for preventing expanding pins from turning around. A slot is adapted to receive the screws. G is the adjustable nut for the operation of the cone in tightening the expanders.

The device nearly doubles the daily output of locomotive piston rings.

Slipping of Drivers.

Editor:

I notice, in Railway and Locomotive Engineering of October, 1913, an article on the subject of locomotives slipping when drifting down hill. As you know, I have not been much interested in the upkeep of locomotives for the last seven years, but I cannot help taking some interest in the subject of locomotive engines slipping, while shut off and drifting down hill.

You and I fought this question to a finish on the old B. C. R. & N., so much so that I thought this old "hoo-doo" had been killed and buried long ago. The worst offender we had was the 16-inch x 24-inch Pittsburgh engine which you brought over from the Chicago, Clinton & Western when it was absorbed by the B. C. R. & N. This engine, which at one time was known as No. 30, was used in light passenger service for many years and run by our deceased friend, John Kimbro. This engine had a faculty for breaking side rods, crank pins, driving axles, etc., every little while and would poke the end of a side rod into the cab, making things uncomfortable for the engineer and fireman. It was not possible for any engine to have worse freaks charged up against it than this engine, No. 30, and as I can recall, the pranks cut up by this engine, in the night, were something hellish. However, the counterbalancing of the driving wheels had nothing to do with this engine. Neither does it have anything to do with any other locomotive engine, so far as slipping when drifting down hill is concerned.

Our engines had the reputation of being the smoothest riding engines of any in the Northwest and were pronounced so by such prominent mechanics of the day as Geo. W. Wilson, Superintendent of M. P. of C. R. I. & P.

I had tried many methods of counterbalancing locomotive driving wheels, the one recommended by the Master Mechanics' Association, included, and in my judgment, the one used by the old B. C. R. & N. was the best. This you will find complete, by one Myers, chief draughtsman of the Grant Locomotive Works, in a series of illustrated papers in the *American Machinist*, some time during the eighties. I had the *American Machinist* complete, for about thirty years, but by accident, they were destroyed. However, this method of counterbalancing by Myers was as follows:

For passenger service—All of the reciprocating weight divided by the number of driving wheels plus the revolving weight, counterbalanced in each wheel.

For freight service—Two-thirds of the reciprocating weight plus the revolving weights, proportioned in each wheel.

All of the old B. C. R. & N. locomotive engines were counterbalanced in this manner as long as I had charge of them, and that was for twenty-five years. Engine No. 30, being a Pittsburgh engine, was supplied with large, dry pipes and steam pipes, and when it met with an accident destroying the main cylinders, I replaced them with a pair of Baldwin cylinders. These always had large steam ports in them, and I concluded that this was the cause of the engine slipping when drifting, with a slippery rail. When the engineer would open the throttle on nearing the foot of a hill, the engine would fly up and slip. Concluding this to be the cause of the slipping, I decided to increase the outside and inside lap on the valve of this engine. I had a pair of new valves made, with ¼-inch more outside lap and 1/16 inch more inside lap. The engineers claimed this was a move in the right direction and advised a little more of the remedy. I had another pair of valves made with still a little more lap, which the engineer thought was just about right. I thought that I had found a remedy for the chronic affliction. However, the engine was put in service on another division in charge of another engineer who complained that the engine was no good, as it did not have enough power to pull a setting hen off the nest. I then cut some of the lap off the valve and kept cutting it off until I had it back to its original size. Then the old hoodoo came back. The engine would fly up and slip and take a side rod strap or a crank pin every now and then. It was worse than ever, and I was at my wits' end, but being no hoodoo man, I knew there must be a cause. I was convinced that it was not in the counterbalance nor in too much steam. When this engine came into the shops, for general repairs, I made up my mind to watch every indication of strikes and slips. I noticed that the firebox was not parallel with the cylinder part of the boiler and that the flange of the front driving wheel on one side was striking the corner of the firebox and that the flange of the back driving wheels

was striking diagonally on the back corner of the firebox, so that when the engine slipped up and rolled from one corner to another, it would produce an alarming sensation.

When the driving wheels of this engine were in the wheel lathe, having the tires trimmed, the lathe man would do a lot of chipping and a lot of tool grinding. I watched this operation for some time and then concluded that this was the hoodoo. I found that this engine had a set of tires of close grain and as hard as tool steel. I had this extremely hard set of driving tires removed and replaced with a softer and more adhesive set. This was the cure. After that, I had no further trouble and thought that this disease in locomotive engines had disappeared until I saw the article in your last number of Railway and Locomotive Engineering. Put on a set of good, soft American driving tires or anneal the set already on the locomotive complained of, and the slipping in running down hill will disappear.

Allan McDuff.

Cedar Rapids, Ia.

RAILROAD FLOAT IN INDUSTRIAL PARADE.

Bessemer & Lake Erie Float.

Editor:

Enclosed herewith is a photograph of a float made by the Greenville, Pa., shop employees of the Bessemer & Lake Erie Railroad Company for use in an industrial parade.

The locomotive was built on a substantial frame which was placed on an electric truck, the wheels rested on the ground which caused them to revolve. A smudge pot in the stack, and whistle operated by compressed air gave the train a very "real" appearance, especially as the means of propulsion was concealed. The tender was a framework covered with canvas and painted. The cars were frame construction covered with roofing paper with painted canvas to represent piles of ore and carried on baggage trucks. The caboose was of the same construction. The appearance of the float on the street was escorted by over eight hundred shop employees.

Chas. C. Richardson.

Greenville, Pa.

The Schmidt Superheater Locomotive.

Editor.

The celebration in Germany last month in commemoration of the equipment of the twenty-five-thousandth locomotive with superheating appliances marks the fact that superheating has now practically become a standard feature of locomotives. It was first applied by Dr. Schmidt, in 1898, on the Prussian State Railways. The first experiments were of the smoke-box type of superheater. This was soon found to have disadvantages, and was soon superseded by the fire-tube system, first adopted by Mr. J. B. Flamme, on the Belgian State Railways. The first experiments of this type were with what was known as the two single-bend series, which consisted of two single elements in each fire tube. Subsequently the two single-bend tubes were combined to form a double bend or four-fold element, and this is generally adopted. To Dr. Schmidt is undoubtedly due the credit of overcoming most of the difficulties encountered in the early experiments. The success of the Schmidt superheater naturally brought competitors, and the result of their work has also met with some measure of success, and the twenty-five-thousandth locomotive referred to as being equipped with the superheater, does not include locomotives equipped with superheater appliances other than those known as the Schmidt superheater.

H. Wagner.

Waco, Tex.

The Leonard Locomotive & Car Shops of The National Transcontinental Railway at Quebec, P. Q.

By George Sherwood Hodgins.

The general layout of the repair shops of the National Transcontinental Railway at Quebec, P. Q., shows that not only has convenience of operation been the guiding principle governing the design, but future needs have also been provided for. Each shop is capable of extension without interfering with any other, and any department can be increased separately as occasion may require.

There are eleven buildings in all, of various dimension, each suitable for the special work to be done in them. These buildings consist of a locomotive, erecting machine, and boiler shop (under one roof), forge shop, freight car shop, power house, planing mill, dry kiln, lumber shed, forge stores and scrap bins, oil house and office building for the executive staff. The total area covered is about five and one-half acres.

There are also extensive store buildings located conveniently near to the locomotive shops and freight car shops, and fitted with the latest improved devices in storing and handling every kind of railway supplies.

In the erecting shop there are eighteen pits, placed transversely, over which a 120-ton crane lifts locomotives into and removes them from, their respective positions. A 20-ton crane, operates over the same area at a few feet lower level, and carries small material and makes many light and rapid lifts.

The "transverse-pit layout" has the advantage of doing away with many side doors in the building for the "in-and-out" movement of locomotives. There are two doors, conveniently placed, through which engines and material enter and leave. This arrangement is economical in the matter of heating. It does away with the necessity of a transfer table with all its inconvenience from snow and ice. The practically unbroken sidewall permits the use of jib cranes, one serving the fronts of two locomotives, being capable of lifting smoke stacks, main valves, smoke-box doors and rings, etc., etc., as the engines are headed toward the wall. The use of these very handy cranes would be most difficult if the wall of the shop had been cut up into a series of doors.

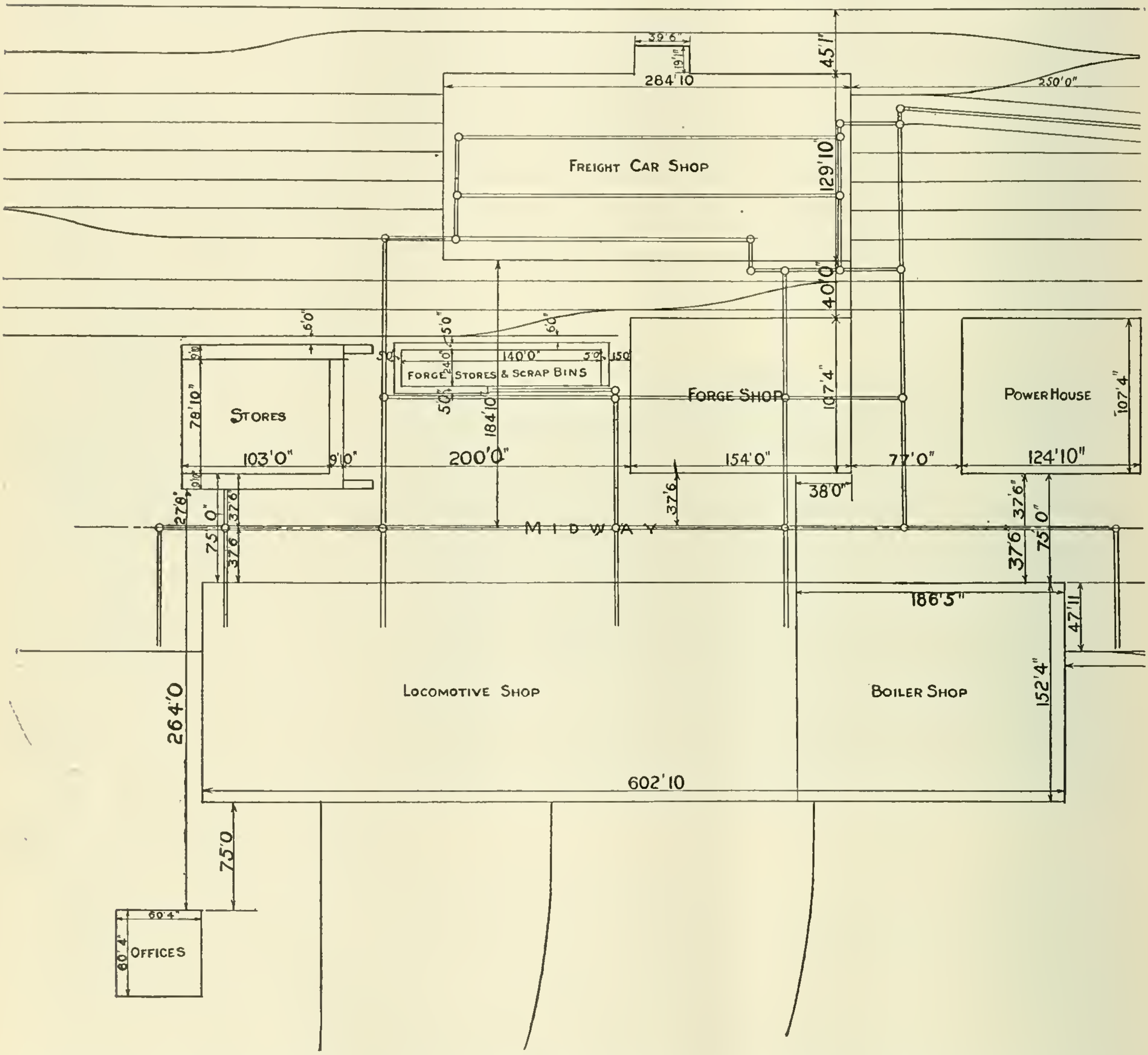
The cross-section of the shop shows the position of the cranes. The large crane is carried on a series of built-up columns, so that the heavy load is central over the line of foundation. As one crane does the work of lifting and placing each locomotive, there is no chance of confusion such as might occur when two cranes are used, and where two men do the work. The single powerful crane has also the advantage over the usual twin

crane arrangement in economy of first cost and maintenance.

All the overhead cranes are provided with effective safety appliances. One of the most important, prevents the load from being "over-wound" by the lifting drum, either by accident or otherwise. It consists of a device which, when the maximum lift has been reached, automatically opens a switch on the hoisting circuit and so cuts off the current, thus suddenly removing the driving power. The cessation of the current immediately brings into powerful action a gravity operated brake, which is normally held out of service by the flow of current.

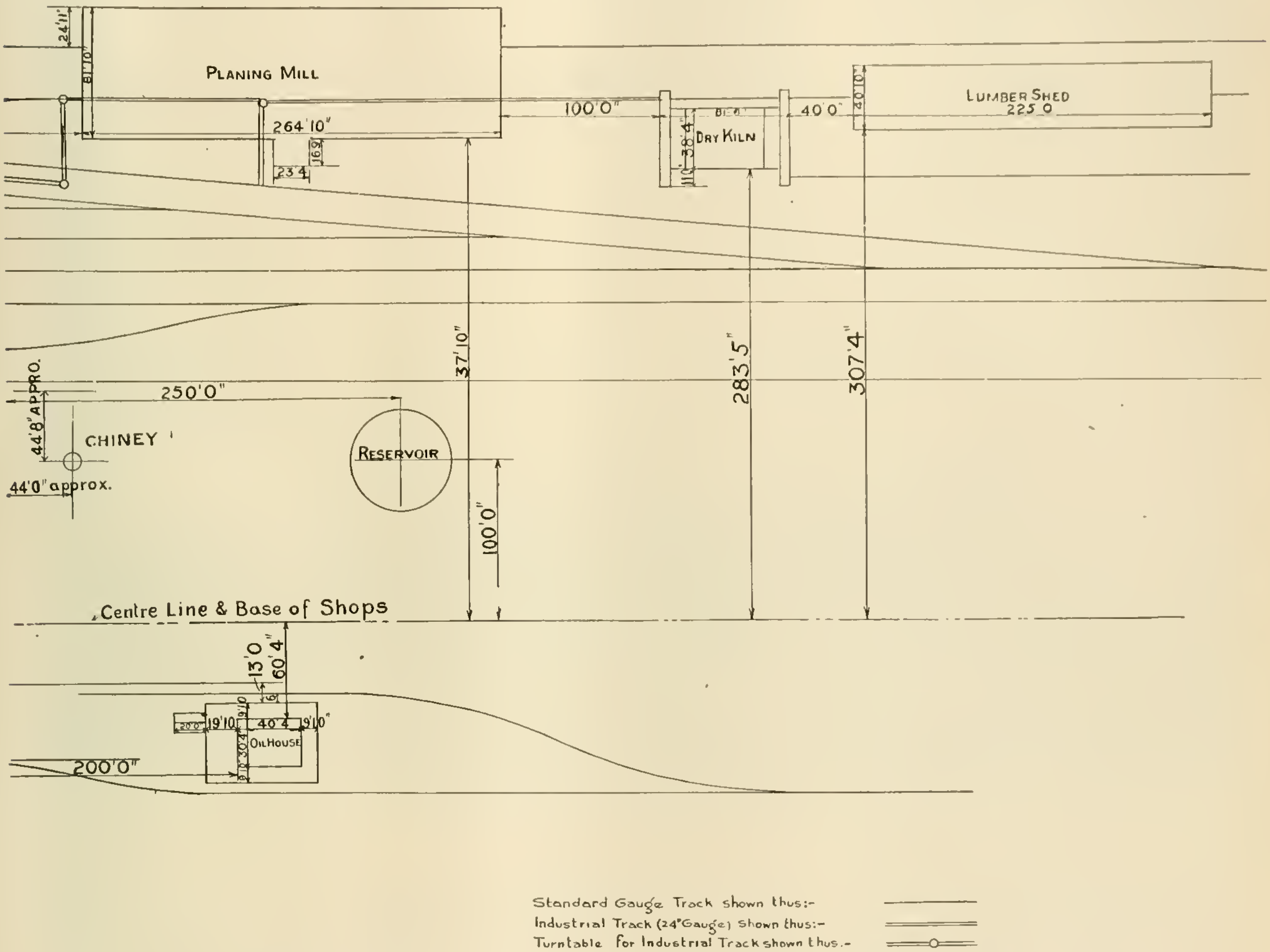
The direction in which the midway crane operates is a new departure in railway shop construction, which has been brought out by Mr. W. J. Press, mechanical engineer of the commission, as it secures substantial advantages. The midway is laid out so as to be alongside of the shops, and not at the ends of the buildings, as is frequently the case. The object of this arrangement is that when material is brought by the midway crane from the storehouse, forge shop, or foundry to the machine, erecting or boiler shop, it is placed at the door nearest to the machine on which the material will be handled, or to the engine upon which it will be used. In this way the delivery of material is not concentrated at one spot at the extreme end of the building. It avoids distribution from a congested area, and it obviates the "long haul" through the shop. Material is laid down at a point as near as possible to its destination, and economy of time and labor, as well as facility in handling is thus secured.

The system of placing machines is such that the movement of material will be in one direction and the distance over which any locomotive "part" is carried, will not be unnecessarily lengthened by journeys forward from one machine and back to another. The continuous one-way movement of material saves time and labor and prevents interference.



The pits in the locomotive shops are supplied with steam, compressed air, hot and cold water. Depressions or grooves in the pit walls carry the pipes. By this arrangement the working space in the pits is not restricted and the pipes are not where they can be easily damaged by workmen dropping material on them, and thus while being quite safe, they are out of the way.

The forge shop and the boiler shop are placed as near as possible to the power house. This is important, for in the case of the forge shop, where hammers are operated by live steam, the short distance between boiler and hammer reduces condensation and delivers steam where it is required with small loss. A similar condition holds good, in a sense, for the delivery of compressed air to the boiler shop machinery. The nearer the source of supply, the less the pipe friction involved and the smaller the losses due to the forcing of air through the pipes.



PLAN OF THE LEONARD LOCOMOTIVE AND CAR SHOPS OF THE NATIONAL TRANSCONTINENTAL RAILWAY AT QUEBEC, P. Q., CANADA.

Industrial tracks form convenient means of communication between the various shops. The buildings, cars, engines and supplies are protected by a water-system arranged to be readily put in use in case of fire. A further protection is afforded by reason of the use of concrete and steel in the various structures.

The shops are situated at Quebec and have been named after Major R. W. Leonard, chairman of the National Transcontinental Railway Commission, under whose administration they were projected. The outlay has been carefully supervised so that excellent results will be attained and full value received for the money expended.

The whole plant has been laid out under the supervision of Mr. Gordon Grant, chief engineer; in such a way that the latest and most modern railway practice has been provided for, and the design will be second to none in the country.

The permanent and substantial character of the shops and the size of the whole plant will be of material advantage to the City of Quebec, by providing steady employment for a considerable number of men the year round. The contract for this important piece of work has been awarded to Mr. Joseph Goeselin of Pt. Levis, Que.

The design and laying out of the plant, the relative size, arrangement and position of the buildings and the selection of the machinery and appliances has been entrusted to Mr. W. J. Press, mechanical engineer of the commission, who has had charge of similar work at the Transcona shops of the National Transcontinental Railway near Winnipeg. The Transcona shops are now being operated. In general plan and in kind and quality of equipment, they are of the most up-to-date type. The Transcona and the Leonard shops (when completed) will embody the latest design and the most modern practice, enabling them to be operated with a very high degree of efficiency. Altogether they will form a most valuable addition to the second of the great national "cross-continent" highways of Canada.

Mr. Tollerton to Traveling Engineers.

At the last Traveling Engineers' Convention, Mr. W. J. Tollerton, superintendent of motive power of the Chicago, Rock Island & Pacific, delivered an address, part of which reads:

The traveling engineer's principal duties are those of education and instruction. The greatest returns will be secured by educational means; discipline should be administered only in extreme cases of un-

willingness to follow your instructions. Discipline freely administered indicates lack of proper instruction, disorganizes your division and should be avoided.

SECURE PROPER MATERIAL FOR FIREMEN.

That the personnel of your engine service may be brought to the highest efficiency, care should be used to secure the right kind of locomotive firemen. Young men with at least a grammar school education, should be selected. And when started out they should be thoroughly instructed along the lines of proper and economical performance of their duties. Do not permit a method of doing their work not consistent with economy. Once they form such a habit, it is more difficult for you to have them perform their work properly. You should ride with newly employed firemen and recently promoted engineers as often as practicable, constantly instructing them. Hold classes with your firemen, endeavoring as far as possible to have men of like experience at the same class meeting, discuss their duties in detail and explain points which are not understood. A number of roads issue instruction books; on the Rock Island the first year's questions and instructions cover combustion; second year, handling of locomotive, break downs, etc.; third year, air brakes and signals. These books should be placed in the hands of young firemen and their details discussed at class meetings. The fireman of today is the engineer of tomorrow, and a careless and indifferent fireman will always develop into that kind of engineer.

HOLD FREQUENT MEETINGS WITH ENGINE CREWS.

At such meetings investigate and explain such factors directly effecting economy in operating costs; discuss rules and other matters which enter into every day life of enginemen. These meetings are not only instructive but are conducive to better co-operation and harmony. Appoint a committee of one or two enginemen to prepare a paper on some live subject to be presented at the next meeting. At terminals a small box should be installed in which enginemen can drop suggestions as to improving the service or for discussion at the next meeting. This exchange of ideas cannot help but be beneficial.

The Federal boiler inspection is being strictly enforced; therefore, it becomes your duty to see that all defects in violation of this law are properly and intelligently reported by enginemen on arrival at terminals. I wish to say a word here in regard to reports of enginemen as to work required. How often do we see on an engineer's work report, "valves blowing." A defective valve may be quickly determined by enginemen before arrival and properly reported, making it unnecessary for roundhouse force to examine both valves. Also "cylinder packing blowing" but no mention made of location. "Engine not steaming." It is unnecessary to state the difficulties with which the roundhouse forces have to contend when such vague reports are made. Enginemen bringing locomotive in can quickly determine whether leaky steam pipes, nozzle stand or other defects prevent proper steaming.

MAKE PROPER REPORTS.

Not giving proper and accurate reports on arrival at terminals calls for greater expense in roundhouse maintenance. Such incomplete work reports result in mechanics spending hours trying to locate defects, which time could be devoted to making needed repairs to other locomotives, thereby reducing one of the growing costs of locomotive operation, i. e., locomotive repairs. Correct reports made by enginemen will enable roundhouse forces to quickly make repairs to the defective parts, reducing time locomotives are at terminals. Under present practice of pooling, particularly freight locomotives, it is most important that enginemen be instructed as to proper and accurate work reports to avoid unnecessary expense. Enginemen in pooled service have a tendency to avoid reporting work, possibly with a view of not being criticised. This can be overcome by proper instruction.

A campaign of education, constantly maintained, will bring about a marked improvement.

INSTRUCT ENGINEMEN IN THE PROPER WORKING OF THE LOCOMOTIVE.

This, with repairing of all steam leaks on locomotives, keeping valves square, cylinder and valve stem packing tight, not only increases the locomotive efficiency but automatically reduces the fuel cost. Fuel represents 42 per cent. of the expense of locomotive operation. Repairs represent 24 per cent. These two items afford the best opportunity for reducing the operating expenses, and it is to you that the management has to look for results. This can be obtained if you get enginemen thoroughly interested.

Members of this association should not only be familiar with the requirements of the Federal boiler inspection law, and penalties for violation thereof, but should instruct enginemen as to their duties therewith.

The importance of the inspection of locomotives should be impressed on enginemen. It is true railroads maintain locomotive inspectors at larger terminals; on branch lines and other places the inspection force consists of enginemen themselves. The proper amount of interest by enginemen will reduce engine failures and improve the service.

SAFETY FIRST.

This brings to mind another subject which is receiving a great deal of publicity at present; that might be called the question of the day—the "Safety First" movement. You can assist greatly in making this a magnificent success. The number of injuries annually to enginemen, due to broken water and lubricator glasses may practically be eliminated by enginemen insisting on shields being properly maintained. Modern locomotives are equipped with bull's-eye lubricators, that do not require shields; also protected water glasses. Some of the older and smaller locomotives are still in service with round tubular lubricator glasses. These are protected by a shield. Some difficulty is experienced in getting enginemen to keep shields in place after same have been applied. Explain to enginemen it is to their interest to properly report shields, headlights, air brake apparatus, safety appliances and similar defects that may cause injury to themselves or others. Follow this closely, as it is one of the largest possibilities in the safety first field.

Eliminate the overloading of locomotive tenders. This will not only assist in avoiding injury but will save fuel.

Be familiar with and fully instruct enginemen as to requirements of the Interstate Commerce Commission on safety appliances, insofar as they relate to locomotives.

Power of Locomotives and Steamers.

Since railroads went into the using of huge locomotives the capacity of the motive power for train hauling is enormous, a train of 5,000 tons being common, but still the capacity of locomotives lay far behind modern steam ships. A very powerful locomotive develops 1,500 horsepower. The engines of the German liner *Imperator* has turbine engines which develops 62,000 horsepower.

Growth of Thermit Welding.

Four hundred locomotive repair shops throughout the United States, Canada and Mexico are now equipped for Thermit welding, a growth of 25 per cent. over the year 1912. In estimating this there is not included a large number of shops where Thermit welds are made but to which materials are sent from other headquarters.

Flashlight Signals in Sweden.

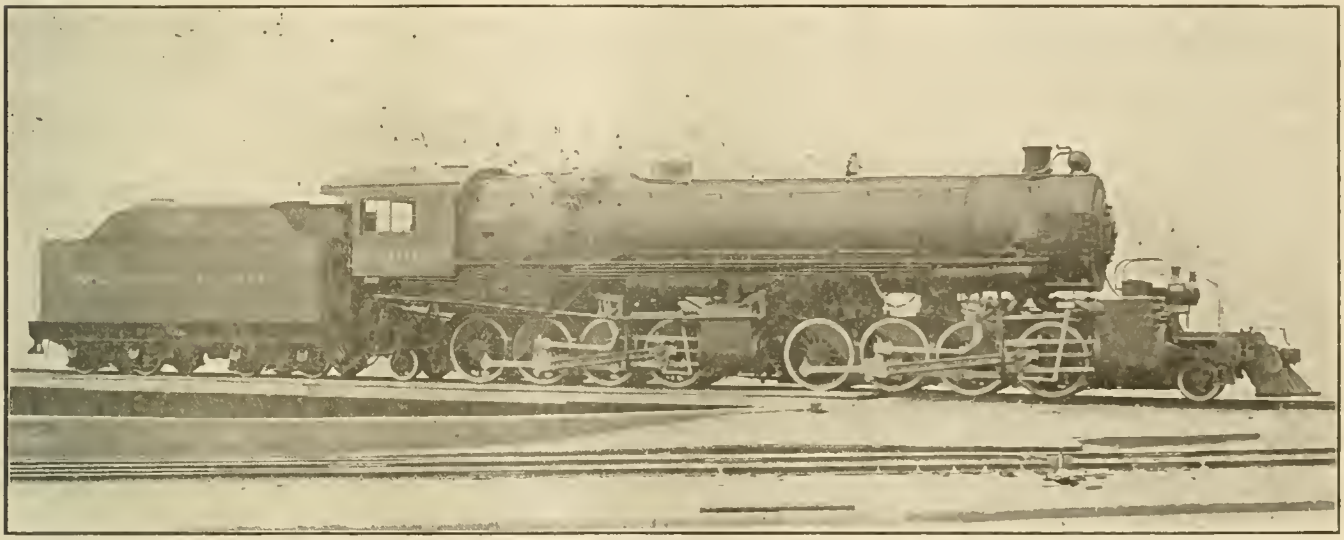
Flashlight railway signals are now in use on the Swedish state railways. The flashing lights for the home signals give sixty flashes to the minute, and the duration of the light is one-tenth of a second, while that of darkness is nine-tenths. The "distant" flashing signals have eighty-five flashes to the minute, and the duration is 0.1 second light and 0.6 second dark. After a year's trial at Liljeholmen station the system has been approved as satisfactory, and the whole line between Stockholm and Saltskog is to be equipped.

Mallett Type of Locomotive for the Northern Pacific Railway

In the September issue of Railway and Locomotive Engineering we presented an illustration and descriptive matter concerning fifty Mikado type locomotives built by the American Locomotive Company for the Northern Pacific Railway. It is gratifying to learn that these latest developments of this comparatively new type of locomotives are more than meeting the expectations of the constructors, and the officials of the mechanical department of the railroad who have now in service more of this type of locomotives than any other railroad in America.

Coincident with this extensive order of powerful Mikados was an order for ten Mallet locomotives of the 2-8-8-2 type, which are a development of a previous design of articulated locomotive that has been very successfully used in helper service on the Northern Pacific. The new and with the new type of locomotives there is no increase in coal over that formerly used.

On the Seattle division, from Ellensburg, Wash., to Auburn, Wash., a distance of 105 miles, crossing the Cascade Mountains through Stampede tunnel west of Ellensburg at an elevation of 2,837 feet above sea level, these powerful new Mallets of the oil burning type are hauling 2,200 tons from Auburn to Ellensburg at a speed from eight to fourteen miles per hour, with a total consumption of 2,645 gallons of fuel oil. From Auburn to Lester, a distance of 43 miles, there is a grade of one per cent., and from Lester to Easton, a distance of 24 miles, there is a ruling grade of 2.2 per cent. for ten miles. On this grade the new Mallets, with one of the older Mallets helping hauls a train of 1,900 tons from Ellens-



MALLET 2-8-8-2 TYPE OF LOCOMOTIVE FOR THE NORTHERN PACIFIC RAILWAY.
H. M. Curry, Mechanical Superintendent. American Locomotive Company, Builders.

class, known as Z-3, Mallets, are used on the Rocky Mountain and Seattle divisions, four with fireboxes arranged for coal burning on the Rocky Mountain division, and six oil burners on the Seattle division. On the Rocky Mountain division from Helena to Blossburg there is a maximum grade against the eastbound traffic seventeen miles long of 2.2 per cent. There are other grades against the eastbound traffic of greater length, notably, after leaving Garrison, there is a grade thirty-one miles in length of 1.4 per cent. On the severe grade between Helena and Blossburg a Mikado of the new type, now known as W-3 class, with one of the new type of Mallets a photograph of which we reproduce, and which, as already stated are known as the Z-3 class, haul 1,750 tons, which, compared with the older types of Mikados and Mallets, show a gain of nearly 30 per cent. as the previous heaviest load recorded was 1,350 tons, burg to Auburn with a consumption of 1,726 gallons of oil.

The new Mallets, both of the oil burning and coal burning types are equipped with superheaters and power reverse gears. The coal burning type of Mallets are also equipped with brick arches. The tractive effort is rated at 87,600 pounds.

The following are the general dimensions of the Mallet type of locomotive:

Cylinders—High pressure, 26 inches by 30 inches; low pressure, 26 inches by 40 inches.

Working Pressure—200 pounds.

Boiler—Type, ex-wag. top; diameter of first ring, 87 11/16 inches; firebox, 126 inches by 96¼ inches; tubes, 262 by 2¼ inches in diameter; 43 tubes, 5½ inches in diameter. Length of tubes, 24 feet. Length of combustion chamber, 56 inches Heating surface, tubes, 5,170 sq. ft.; firebox, 368 sq. ft. Total heating surface, 5,538 sq. ft. Superheater heating surface, 1,249 sq. ft. Grate area, 84.3 sq. ft.

Weight in working order—462,000 pounds; on drivers, 401,000 pounds; on leading truck, 34,000 pounds; on trailing truck, 27,000 pounds. Weight of engine and tender in working order, 655,000 pounds.

Wheel Base—Driving 15 ft.; wheel base, total, 55 ft. 2 in.; wheel base, engine and tender, 83 ft. 6¼ in.

Wheels—Diameter of driving wheels over tires, 57 in. Driving journals, main, diameter and length, 10½ in. by 12 in.; other driving journals, 10 in. by 12 in Engine truck wheels, diameter, 30½ in.; engine truck journals, 7 in. by 13 in.; trailing truck wheels, diameter, 30½ in.; journals, 7 in. by 13 in.

Valves—High pressure valves, piston. Low pressure valves, slide. Diameter of high pressure valves, 14 in.; greatest travel, 6 in.; outside lap, 15/16 in.; inside clearance, high pressure valves, ¼ in.; low pressure valves, 7/16 in.; lead, high pressure valves, ⅛ in.; low pressure valves, 3/16 in.

Water capacity—10,000 gals. Coal capacity, 16 tons.

Panama-California Exposition.

Arrangements have been made by Mr. E. J. Chapin, traffic director of the Panama-California Exposition, San Diego, Cal., whereby all exhibits destined to exposition will be returned carriage free, the goods to be returned by the routes that originally carried the same. Special low rates have also been obtained from the Pacific Coast Steamship Company, Pacific Navigation Company, and other coastwise steamers. Rates and terminal charges may be had on application to any freight agent in the United States and Canada.

Catechism of Railroad Operation

NEW SERIES.

First Year's Examination.

Q. 1.—What are the obligations of the fireman to the company employing him?

A.—The fireman should always be ready for duty when needed, and should be at his home or place of residence ready for a call unless given the privilege of a certain time to be away, and he should be sure to be back at his calling address when his leave of absence has expired.

Note.—The importance of this lies in the fact that in case of an emergency where a man is needed on short notice he will be available, and the company assumes that he can be relied on at all times when he is given employment.

Q. 2.—What are the duties of the fireman when called for a run?

A.—He should get to the roundhouse as soon as possible, making sure that he is there in ample time to prepare his engine for the run without delay.

Q. 2½.—What are the duties of the fireman on arrival at the roundhouse previous to going out on a trip?

A.—He should report to the engine dispatcher or foreman in charge, and find out which engine he is to get, see that all firing tools are on the engine and in good condition, draw the necessary supplies for the trip (such as oils, waste, packings, extra water glasses and lubricator glasses with gaskets, etc.), see that the fire is in good condition and ready for the trip, and while examining fire note the condition of the fire box sheets and flues, examine the grates and the ash pan, see that there is a full supply of coal, water and sand and that lights are in proper condition for use and in their proper place, see that the necessary flags, fusees and torpedoes are on the engine, and read all bulletins.

Q. 3.—Upon arriving at the engine what are your first duties?

A.—To see that the boiler has plenty of water in it to protect the crown sheet, by trying the gauge cocks and comparing them with the water glass, then see that the fire is in proper condition.

Q. 4.—Have you acquired the habit of comparing time with the engineer's time and do you insist on seeing all train orders?

A.—Yes.

Note.—The importance of seeing all train orders is that it is a protective act; not only do you protect yourself, but others as well, when you know where the meeting points are, and it enables you to handle the fire in the most economical and scientific manner.

Q. 5.—What is the most important duty of the locomotive fireman?

A.—To produce the greatest amount of steam with the least possible amount of fuel.

Note.—The cost of fuel on the railroad is one of its greatest expenditures, and the fireman who can produce the necessary heat to evaporate the greatest amount of water with the least amount of fuel consumed is the most valuable man—his economy will more than pay his salary.

Q. 6.—Does a knowledge of the principles of combustion, from a scientific point of view, aid in fuel economy? Why?

A.—Yes, because if a fireman knows just the conditions necessary (and how they are obtained) in firebox to produce the greatest amount of heat, he will be able to produce the heat many times when conditions are not the best.

Q. 7.—What is the composition of "bituminous" coal?

A.—Bituminous coal is composed of carbon (fixed and free), hydrogen, water, oxygen, nitrogen and ash.

Note.—The fixed carbon is what we call coke and the free carbon is the part that goes away as black smoke if not consumed in the firebox, the hydrogen is a gas and produces great heat, the ash is the residue of combustion and if clinkers are formed it shows that the coal had some iron and sulphur in it which is called by the chemist "iron perides."

Q. 8.—What are the heat producing substances in the bituminous coal?

A.—Carbon and hydrogen.

Q. 9.—What is combustion or of what does burning consist?

A.—Burning or combustion is the chemical combination of a fuel element with oxygen.

Q. 10.—What three things are essential to produce combustion?

A.—To produce burning or combustion it is necessary to have the oxygen, the fuel and the temperature at which they will combine.

Q. 11.—From what source do we get the oxygen that combines with and burns the carbon and the gases?

A.—We get the oxygen from the atmosphere.

Note.—The oxygen is one-fifth part of the air we breathe, the other four-fifths being nitrogen.

Q. 12.—Are we liable to get too much oxygen for perfect combustion of the fuels? Why?

A.—No, we are not liable to get too much oxygen, because the fuel elements will not take more than they need to make the right combination.

Q. 13.—In what proportions do the oxygen and carbons combine and what are the results?

A.—The proper proportion of oxygen to combine with carbon is two parts of oxygen to one part carbon, but carbon will combine with one part of oxygen to one part of carbon, and in this combination it will produce only one-third the heat that results from the proper combination.

Q. 14.—How does the hydrogen combine with the oxygen?

A.—Hydrogen requires but one part oxygen for two parts hydrogen and will not combine in any other way.

Note.—Hydrogen is one-sixteenth the weight of the air and being very light will escape to the atmosphere unconsumed unless the oxygen is in firebox to combine with it.

Q. 15.—Is it a good plan to have more oxygen in firebox than is used? Why?

A.—Yes, because the excess amount will be used when the fresh fuel is first placed in firebox and the gases are being rapidly given off.

Q. 16.—How is forced draught created in the firebox? Why is it necessary?

A.—The forced draught is created by the exhaust forming a partial vacuum in the front end (smoke box) and the air, which will flow into any space which is not already filled with something as dense as the air, will flow up through the fire and furnish the oxygen for burning. It is necessary to create the forced draught in order to get the required amount of oxygen into the firebox for the rapid burning of the fuel to produce the heat and steam for the cylinders.

Q. 17.—Describe the condition in which your fire should be when ready for the trip, and say what you would do to get it in that condition with either bituminous or anthracite coal?

A.—The fire should be level and burning brightly and free from clinker or any dead spots. To get the fire in proper condition, I would clean out all ashes and clinkers, put fresh fuel in the light spots, adding a little at a time until the fire was level and of the proper thickness.

Q. 18.—State how you would fire the engine while running along, to obtain the best results, with either bituminous or anthracite coal?

A.—I would supply the fuel to the fire as it was being consumed, keeping the fire

of an even depth and burning at a dazzling white heat all over, by firing into the lightest spots in small charges, in that manner producing all the heat possible and wasting none of the fuel.

Note.—The coal should be broken up into small pieces for best results.

Q. 19.—What would you do with the coal to prepare it for the fire so that best results would obtain in heat and economy?

A.—I would break the coal up into pieces about the size of an apple to prepare it for the fire.

Q. 20.—Why is it very important that bituminous coal should be broken up so that the pieces will not be larger than an apple before being thrown into the firebox?

A.—Because the oxygen must be in actual contact with the fuel for burning, and by having the coal broken up into small pieces it exposes a larger surface to the oxygen, consequently getting more of the fuel burning at once creating greater heat.

Q. 21.—In what condition should the fire be maintained in regard to its depth and thickness with either bituminous or anthracite coal?

A.—The fire should be kept at a proper thickness and even all over, to prevent any holes being torn in it which will allow cold air to reach the flues, and at the same time thin enough to admit sufficient air to furnish the oxygen to combine with the fuels that are in the form of gases above the fire.

Q. 22.—Does the amount of air admitted to the firebox have any influence on the amount of fuel consumed or heat produced? State why it does.

A.—Yes, unless the necessary amount of oxygen is present in the firebox to combine with the gases as fast as they are given off, they will go out through the flues (helped by their lightness and the forced draught) unconsumed and a total loss, and all the heat we will get is from the fixed carbon which will be only about one-third or one-fourth of what we should have gotten from the fuel placed in the firebox.

Q. 23.—Why is it important that the fire be kept at an even depth all over and free from clinkers and ash?

A.—It is important that the fire be of an even thickness all over to insure the air, of which the oxygen is a part, be admitted in the same volume at all points so that the oxygen will come in actual contact with the fuel and keep the fire burning brightly over its entire surface, and the temperature high enough for the combination of the oxygen with the fuels.

Q. 24.—At what temperature do the fuels combine with the oxygen?

A.—Best results obtain with a temperature of not less than 1,800 degrees.

Q. 25.—What is the temperature in the firebox when the fire is burning brightly all over its surface?

A.—It is from 2,200 to 2,800 degs. Fahr.

Q. 26.—Does the nitrogen which enters the firebox benefit the fire? If not, what is the effect of it?

A.—No, the nitrogen is a dead loss but must be passed through the firebox to get the oxygen that is mixed with it in the air, and it uses up some of the heat in the firebox.

Q. 27.—In what manner does the condition of the fire with regard to depth, holes, banks, or clinkers affect the admission of air?

A.—If the fire is too thick the air cannot get through it in sufficient quantity; if there are holes in the fire the air will take the line of the least resistance and enter the fire box in large quantities and pass through the flues cooling them as well as the temperature of the firebox, and the air does not come up through the fire where it will touch the fuels with the oxygen and there can be no burning. Banks and clinkers force the air to come up through the thinner parts of the fire so the fuel on top of the bank or clinker gets no oxygen and produces no heat.

Wanted Terrific Train Speed.

Some curious discussions arose in the early days of railway operations concerning the safe control of trains and the speed that could be accomplished by engines pulling paying trains. One set of investigators insisted that a speed of 300 miles an hour was probable, while the other side held out for 60 miles an hour as a safe and comfortable pace. Zerah Colburn, the famous pioneer engineering writer, took the matter seriously and argued against the high speed demanded by the extremists. He calculated by figures, that could not lie, that it would call for 250 tons of coal per mile to make locomotives pull a light train at a speed of 300 miles an hour.

First Ten Wheeler.

When the hauling of heavy trains first raised a demand for heavier locomotives than the 4-4-0 in general use, the managers of the Hinkley Locomotive Works, of Boston, after much serious deliberation determined to build an engine with six driving wheels coupled, the form that afterwards became known as ten wheelers 4-6-0. That was in 1851.

The first engine of that type built had outside cylinders 13½ x 20 inches and weighed 38,000 pounds. The engine proved very popular and soon led to the construction of many others of the same form.

"Popping Off."

Enginemen and firemen of the Baltimore and Ohio lines have been asked to use every effort to prevent locomotives attached to trains standing in passenger stations and at other places around terminals from "popping off," as it is expressed in railroad parlance, or belching forth volumes of steam. The officials explain that frequently it happens that passengers hurrying past a locomotive to board their train are startled by a sudden "popping off" of a locomotive, and there is a possibility that persons might be frightened to such extent as to cause serious harm. A mother, for example, carrying an infant in her arms and looking after the safety of young children traveling with her, might be scared by a "popping" engine and drop the child; or a person carrying a valuable parcel might be surprised to the degree of dropping the package and breaking its contents.

Aside from the protection which this new rule affords to passengers, the railroad company hopes to affect an economy in the use of fuel and energy because it is a well known fact that the needless waste which results from engines blowing off steam tends to run up the charges of conducting transportation. Railroad employees who handle their locomotives according to the most advanced methods of operation seldom permit the engines to "pop off." Officials state that it is possible to attain the greatest efficiency from a locomotive without wasting a pound of steam.

Lubricating Oil for Belgian State Railways.

Contracts will be awarded in November or early in December for supplies of lubricating oils for the Belgian State Railways for the first six months of 1914. These contracts are awarded to the lowest bidder and any American firm desiring to submit bids should write at once to Mr. Flamme, Administrateur de la Traction et du Materiel, Ministere des Chemins de Fer, 13 Rue de Louvain, Brussels, requesting that the specifications of these contracts be sent to them as soon as they are issued. No contracts are awarded except to firms having an office or connection in Belgium. An American consular officer has forwarded copies of the general conditions of the Belgian State Railways for the submission of all bids for supplies and the special conditions regulating bids for supplies of mineral and lubricating oils. These contracts are very important and interested firms should lose no time in getting in touch with the proper officials.

Questions Answered

VARIATIONS IN LEAD IN THE WALSCHAERT'S VALVE GEAR.

J. E. B., Tucson, Ariz., asks: Is it possible to arrange the Walschaerts valve gear to give the valve ⅛-inch lead in the forward motion and ⅛-inch negative lead in the backward motion, and, if so, what effect on valve would this arrangement have when reverse lever was "hooked up"? A.—It is an easy matter for the constructor to arrange the parts of the Walschaerts valve gearing to suit any required amount of lead. The combination or lead lever gives the amount of lap and lead required and the relative distance between the center of the pin connecting the valve rod and the center of the pin connecting the radius rod, and their relation to the length of the combination lever determines the amount that the valve is moved from the exact center of the valve seat at the end of the piston stroke. In regard to the valve having a variation in the amount of opening on the forward as compared with the backward motion of the engine, such a variation would require that the eccentric crank should be set at some distance away from the exact right angle to the main crank, which is the proper position when it is desired to have the valve openings exactly square on both forward and backward motions, the exact amount of the variation depending on the dimensions and relative proportions of parts. When the reverse lever is "hooked up" the amount of lead on both backward and forward gears, assuming that all the parts are properly adjusted, remains unchanged. It may be added that assuming a locomotive equipped with the Walschaerts valve gear, and the gear so constructed and adjusted that ¼-inch lead of the valve occurs on all points at the end of the piston strokes, and it was contemplated to make the changes suggested in the question, it would involve a change in the relation of the connecting points of the combination lever and also in the position of the eccentric as already pointed out.

FRAME BREAKAGES.

E. E., Portsmouth, Va., writes: We are having a number of frame breakages recently on locomotives of the Consolidation type. These engines are from 150 to 175 tons in weight, with cylinders 21 inches by 28 inches, and carry 200 pounds steam pressure. They are hauling 65 cars on a level road, amounting to about 2,100 tons. What is the cause of the increased number of breakages of frames? —A. All breakages of this kind occur from shock or overstrain. Frame breakages occur mostly at curves on the railroad. Running round a curve at a high speed, and with a locomotive set at a high center of gravity, as all large modern locomotives are, the strain or shock on the frames is excessive. The increased size of frames and the improved quality of the steel, especially since the introduction of vanadium tends to reduce the breakages to a minimum. It may be added that loose wedges, and the slipping of wheels while drifting also add to the number of breakages, but generally speaking locomotive constructors are meeting the requirements of the situation with a degree of skill that has succeeded in reducing the number of breakages. Very likely there is some added cause on your road that would require special investigation.

FORCE OF A MOVING TRAIN.

W. L. B., Bonavista, Newfoundland, asks.—What is the rule that applies to finding the energy to be destroyed in stopping a train at a speed of ten miles an hour, or the energy the brake has to destroy in stopping a train? A.—A velocity of ten miles per hour is equal to 14 ft. 8 ins., per second. The formula reduced to its simplest form is to multiply the weight of the train by the square of the velocity and divide the product by 64.32. For example, supposing the train weighed 100 tons, then $100 \times 14\frac{2}{3}^2 = 20500 \div 64.32 = 302$ foot-tons.

LAP AND LEAD.

G. C. B., Oakland, Cal., writes.—Kindly advise me what is the rule used in regard to lap and lead on piston valve engines, also on the Baldwin compounds. In the principal shops from New Orleans, La., to San Francisco, Cal., there are not two that have the same system. A.—Lap consists in lengthening the valve face, so that when the valve stands in the center of the seat, the edges of the valve extend a certain distance over the steam ports. This extension is, properly speaking, outside lap, and its effect is to close the steam port before the piston reaches the end of the stroke, and the point at which the steam port is closed is called the point of cut-off. In some cases the inside edges of the valve cavity do not reach the inner edges of the steam port. This is called inside lap, and its effect is to delay the release of the steam and prolongs the period of expansion. It is of some advantage in slow working engines. The amount of lap depends on the kind of service the engine is intended to perform and varies from ½-in. to 1½ in. With a given travel the greater the lap the longer will be the period for expansion. The lead of the valve is the amount of opening of the steam port when the piston is at the end of the stroke, and varies from zero to ⅜-in. The amount of lap is a matter of design by the constructors, the amount of lead is a matter of adjustment particularly in the case of locomotives equipped with the Stephenson valve gear. In the Walschaerts and Baker valve gears, the amount of lead desired is also calculated in the design of the constructor, as the combination lever controls the amount of lead. The designs and methods of adjustment are the same in both simple and compound engines, and also whether the valves are of the D-shaped or piston variety.

MALLETS, CYLINDERS AND AIR PIPES.

W. T. K., Bluefield, W. Va., asks.—(1) Are the cylinders on some types of locomotives inclined at an angle to eliminate the angularity of the main rod? (2) How may a Mallet be brought to the shop when any one of the four engines are crippled, for instance, if the valve gear was broken on a low pressure engine? (3) In case of a complete air failure would it be practical or safe to connect steam to air reversing gear in order to bring engine to shop? A.—(1) the setting of the cylinders on some locomotives in an angular position has no effect whatever on the angularity of the main rod. The inclination is usually rendered necessary on account of some structural peculiarity in the saddle or other part of the locomotive to which the cylinders are attached. (2) A breakage on a Mallet locomotive may be treated in every way almost the same as an ordinary simple locomotive. In regard to a valve gear fracture, the broken parts should be removed and the steam valve fastened in the center of the valve seat. (3) It would be impossible to connect steam to air pressure fittings while a locomotive was in active service, unless a special system of piping had been previously constructed to meet such an emergency.

FASTEST LOCOMOTIVES.

C. E. C., Dunmore, Pa., asks: (1) What is the highest rate of speed that has ever been made by a locomotive, with or without train, in a test of speed? (2) Has any dynamometer test been made to determine whether there is any difference in the drawbar force necessary to push heavy loads on the rear end of a train of empties or by hauling on the head end of the same train.—A. (1) A record of 112½ miles an hour, made May 11, 1893, by the New York Central locomotive No. 999, was claimed for a number of years to be the record for speed. The record has been disputed as the speed was not maintained for more than a few miles. In July, 1904, a locomotive on the Philadelphia and Reading ran 4.8 miles in 2 minutes and 30 seconds, which is equal to 115.20 miles an hour. (2) No recorded tests of this kind have been made public, but that there would be considerable dif-

ference is well known, as more force is required, to push a train of cars than is necessary for hauling the same train. This may be readily illustrated by hauling a chain, and trying to push the chain where the tendency to buckle is very great. The variation in the case of a train would depend on the condition of the rolling stock and the track.

SPEED OF TRAINS.

B. J. Sarnia, Ont., asks.—What is the highest rate of speed on the railroads in the United States according to the published schedules, and how far do they surpass, if any, the rates of speed made by Canadian trains? A.—It would be a task which would require time to examine all the schedules of fast trains both in the United States and the Dominion of Canada, but it may be stated that the Twentieth Century Limited has recorded speeds of 60 miles an hour, notably between Elkhart, Indiana, and Toledo, Ohio, the distance being 133.4 miles, which has been repeatedly scheduled, and also traversed, in 133 minutes. On the Pennsylvania Special the distance between Jersey City, N. J., and Harrisburg, Pa., a distance of 188.4 miles, the schedules have been published and the runs accomplished in 193 minutes, making an average rate of 58.6 miles an hour. Special runs on various roads exceed these figures, but we do not recall seeing schedules of similar distances surpassing the rates of speed.

DE GLEHN COMPOUND LOCOMOTIVES.

W. G. L. Staatsburg, N. Y., writes:—Nine years ago in describing the Pennsylvania railroad company's De Glehn compound locomotive, you stated that when the results of tests were made public you would publish them. As this was not done, I assume that results were not made public because the locomotive was a success. If it had not been a success the statement that American locomotives were superior to French would have been heralded throughout the land. Is my assumption correct?—A. No. The assumption is wrong. The Pennsylvania De Glehn locomotive referred to was a part of the company's exhibit at the Louisiana Purchase Exposition at St. Louis, Mo., and was much commented upon by the engineering press at the time. Its success was not particularly marked. Like most other compound locomotives of that period it gave evidence of good service for the first few months, but after a period of hard service many compound locomotives acted like ships that had sails set to move both ways at once. The average roundhouse foreman's life was too short, and the available forces too limited to maintain the complex adjuncts of the compound locomotive in perfect condition in the limited space in the kind of locomotive referred to. A return to first principles was inevitable, and so the De Glehn ran its brief career, and gave way to the more commodious and more powerful Mallet. Particular descriptions of the De Glehn were published by us in March and July, 1903, and in July, 1904, and final editorial comments on the lessons to be learned from the rise, fall and decline of the De Glehn in October, 1908, page 433, which were extensively copied and endorsed by the engineering press at that time.

VARIATIONS IN MALLETS.

L. W., Newburg, N. Y., writes.—The Pennsylvania simple Mallet has cylinders 27 inches diameter. The large Santa Fe Mallet has high pressure cylinders 28 inches diameter, and low pressure cylinders 38 inches diameter. Now as there is no back pressure on the pistons of the Pennsylvania locomotive, and there is back pressure on the high pressure pistons of the Santa Fe locomotive, either the rear unit on the Pennsylvania must tend to slip, or the rear unit on the Santa Fe must be deficient in tractive power. Can you enlighten me on this? A.—The Pennsylvania locomotive carries a steam pressure of 160 pounds, and develops a tractive force of 99,200 pounds, with a weight on driving wheels of 437,500 pounds. The ratio of adhesion is therefore 4.4. The Santa Fe Mallet carries a steam pressure of 225 pounds, and the high pressure engine develops a maximum tractive force of approximately 60,000 pounds. The estimated weight on one group of wheels is 275,000 pounds, so that the ratio of adhesion is 4.6. Both these ratios are within the limits of good practice, and neither indicates a "slippery" engine.

BRAKE CYLINDER PRESSURE.

W. G. L. writes: Why is there no high-speed reducing valve or compensating valve, that will reduce brake cylinder pressure, included with the L. N. and P. C. brake equipments? A braking power that will not slide wheels at high speeds may do so at slow speeds and thus increase the length of stop.—A. With the L. N. equipment a safety valve set at 62 pounds is used to limit service brake cylinder pressure and with the P. C. equipment, the braking power is based upon 86 pounds cylinder pressure which is the point of equalization between service reservoir and service brake cylinder.

As to the emergency when the shortest possible stop is desired, a great number of experiments in train stops with modern equipment have demonstrated that the shortest possible stop that can be made is by crowding all of the compressed air available into the brake cylinder and holding it, hence the safety valve of the L triple valve is cut off in emergency position and the second cylinder of the P. C. equipment is brought into use and full braking power is held to the point of stop.

Each car furnishing its own braking power, the wheel sliding cannot occur until so near the point of stop that any that might occur will not materially affect the length of stop or damage the wheel.

LENGTH OF TRAIN STOP.

W. H. M., Wheeling, W. Va., writes: In what distance can a train of six passenger cars be stopped by an emergency application of the brake on a level track, 70 pounds brake pipe pressure and 110 pounds brake pipe pressure, speed 70 miles per hour?—A. As 70 pounds pressure is not used in modern passenger service we assume that you wish to make a comparison between the quick action automatic and the high-speed brake. Quick action at 70 pounds pressure, high speed at 110.

The air brake tests conducted at Absecon, N. J., indicate that the same train can be stopped in 26 per cent. less distance with the 110 pounds pressure or high speed brake, than with the 70 pounds brakepipe pressure.

A train of 1 locomotive, 6 coaches and 1 chair car running at a speed of 70 miles per hour on a level track was stopped with an emergency application in 1,850 feet by the quick action brake and in 1,350 feet by the high-speed brake.

Stops from 60 miles per hour speeds under similar conditions were made in 1,350 and 1,050 feet, respectively, the later stop of 1,050 feet being about the best performance of the high-speed brake.

COMPENSATED CURVES.

J. R. M., Ogden, Utah, asks: What is meant by compensated curves in railroad construction.—A.: A compensated curve means that where a curve occurs on a grade, the grade is reduced so that the total resistance of the curve and grade would be equal to the same resistance on straight track; as, for instance, the resistance due to grade for a one per cent. grade is equal to 20 pounds per ton. If, now, a curve should occur on this grade, it is plain that a locomotive could not pull the same number of tons around the curve and up the grade that it could were no curve existing; hence the grade is reduced on the curve to make up for the increased friction due to the curve. This is usually accomplished by reducing the grade .4 of one per cent. of the grade for each degree of curvature.

Ox hair brushes are being used in the Grand Trunk railroad shops with excellent results. The piece workers are able to get over the cars in shorter time

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Railroad Valuation.

The Interstate Commerce Commission has its work cut out for it, when it begins the task of the valuation of railroads. It is doomed to everlasting servitude, because it is enacted that it shall report to Congress at the beginning of each regular session until the task is done, and at the same time it shall report every change in values of every kind. It would be interesting to know by what kind of legislative juggling the job could be said to be done, while changes must necessarily continue to go on. Coming to the main question, however, which is really the only question: What is this valuation for? It is to find a supposed scientific basis for railroad rates—both passenger and freight. This cannot be done by the means proposed, for this contradiction is visible—if a passenger rate is rightly low in a crowded territory where prosperity flourishes, then a rate ought to be high where the population is sparse and poor and journeys necessarily long. Yet from the pocketbook point of view the crowded region could stand high rates better than the thin region.

When the enormous task of the Interstate Commerce Commission approaches completion and the Federal government can prevail over all the jangling, confusing railroad laws of all the States, then it seems possible to fortell a general advance instead of a decline in rates, both passenger and freight; and for this reason: railroads must come to the point of providing out of earnings a sinking fund for reproduction and thus avoid everlasting dependence on the money market for bonds piled on bonds and obligations plastered on every decaying asset. The unwise agitation against railroads on one hand and the former indefensible independence of public service on the part of railroads on the other hand has reached its limit in this scheme. In the years that will elapse before the task approaches its first form of completion, the common sense of the railroad magnates must work out the idea of a sinking or replacement fund for property and "amortization" for the bonds; for indefinite extension of bonded indebtedness is impossible.

The Roundhouse Foreman.

Nearly all positions of trust on railroads have responsibilities that try the hearts and patience of the holders; but we think that there is no position connected with the mechanical department that requires more judgment, tact and energy, than that of roundhouse foreman at a place where many engines have to be sent out daily and nightly, especially if the motive power is below the requirements of the train service. Some railroads are so fortunate as to have all the power required, which makes the roundhouse foreman's position easy; but these are the exception, especially when business is rushing and there are few companies that do not sometimes have more trains than can be handled without straining the resources of the power available.

In the days when every engineer followed one engine and a regular engine was assigned to every train, the work of the roundhouse foreman was comparatively easy; but with the modern practice of the chain gang—first in first out—the problem of getting the engines out on time is nearly beyond human capability. When a crowd of engineers and firemen armed with lunch pails, every man anxious to take his place on the first engine to arrive, unusual patience is needed to treat all the crews fairly and there is much temptation for the foreman to send out engines that have not received the proper attention, inspection and repairs.

Reporting the repairs needed on incoming engines is an important matter that is sometimes badly neglected. An engineer arriving on an engine that he may not ride upon again for weeks, is under temptation to neglect the reporting of work required to be done; but the rules covering the making of reports ought to be sufficiently strenuous to impress upon every engineer the importance of making out proper reports. The duty towards his fellow engineers ought also to prevent carelessness in the performance of this important duty.

A common situation is for the roundhouse foreman to be studying the work book while the road foreman of engines is at his elbow saying: "How soon can I have that engine? It is time she was out in the yard; the train despatcher is calling for engines." The particular engine called for has work reported, so the roundhouse foreman is in a fix, for he knows that if the engine goes out without the repairs being made and breaks down on the road, neither road foreman or train despatcher will be held accountable and that the master mechanic will call him to account for the work reported not having been done. It is the best plan for the roundhouse foreman to adopt the standard rule, that no engine can be sent out that he would not be willing to run.

Following this rule the foreman orders his workmen to hustle the repairs as quickly as possible. He orders Janson and Sullivan to put in a new spring and hurry up. Morgan is told to patch certain boxes and to hurry up, and when that engine is almost ready to move the engineer comes in and mentions that he had forgotten to report that the right hand injector was working badly and that the left hand backing eccentric strap was running hot.

By this time several more engines have arrived, all of them having work reported. The roundhouse foreman now proceeds to assign workmen to the several jobs and finds that Janson and Sullivan are still wrestling with the spring they were going to apply, the holes in the spring being too small for the hanger to go through. The spring-maker comes in for the kind of blessings that workmen send forth, but that does not hurry up the work. The workmen are annoyed when the tools they are called upon to use are out of order, but the foreman has to bear the burden, which on the whole is just, for it is his duty to see that all appliances for doing the work are in proper working condition.

The position of roundhouse foreman is a difficult one at the best, but the hardships may be greatly modified by having an efficient organization. In the first place there must be gangs of good, efficient workmen, and the foreman has it in his power to make them good or bad. He must by his own push and energy show them that he is the true leader and, going ahead, speak words of cheer and encouragement when needed and give them praise and credit for good work accomplished. Again he must know his men and

have the same men or pair of men perform the same work when that is practicable. For instance, the same pair of men should do all the spring and running gear work; another gang should do all the smoke-box work; another gang does all the work on passenger engines, including the air brake, injector and lubricator repairs. By keeping the same set of men on certain work they become very expert and collect the necessary tools. Tools are a very important item in roundhouse work and on their good selection and maintenance the efficiency of roundhouse operations depends to a great extent.

The Training of Railway Employees.

It is quite possible that the press and the public generally give more attention to the marked improvements in mechanical appliances used on railways than they do to the better training of railway men. While it is generally admitted that the apprentice system is being improved, and educational facilities are being placed within the reach of the humblest, it is not generally known that the organization of workingmen into mutual protective associations has had not only an educational advantage of the most beneficial kind, but has been the means of opening up a kindlier current of feeling among the workingmen towards each other. The old absurdities that crystallized into the intangible form of trade secrets are becoming revealed into the thin air which they always were and the young men are being taught by their elders all that years of experience has taught them without the dread of letting the younger men know too much. It is amusing to look back through the gathering mists of years to the time when valve setters and fancy finishers and other mechanics who were engaged in what may be called the finer parts of involved mechanism were really men of mystery, and like veiled prophets were not to be approached while engaged in their mystic performances.

Mechanical operations that could be learned by any intelligent mechanic in a few hours, were kept hid for many years, and even those in authority seemed favorably disposed towards keeping the rank and file of workingmen in some kind of dread of each other, doubtless with the idea that they would be more subservient to the powers that were. Those phases of intercourse, or rather lack of intercourse, have almost vanished, and the railway official particularly observes that one of the problems confronting him is the proper training of men so that they are capable of filling positions of responsibility. The multiplex duties involved in railway service renders this not only desirable but necessary and hence a class of men infinitely superior to the class of men of forty or fifty years ago are now already in the railway field and their acquirements and capabilites seen constantly growing.

Apart also from the benefits of a better education and closer association among workingmen is a growing feeling of relationship in the material interests involved. It is gratifying to observe that a large number of railway employees are learning to invest savings in the railroads on which they are employed, and while this may seen at first thought to be attempting the impossible in these days of high cost of living, it is marvelous what high thinking and plain living can accomplish and what habits of thrift can make possible when a light is placed in the mental vision that leads to a broader social foundation, and creates a deeper and more abiding interest in the work which we are called upon to do.

It need hardly be added that the wider diffusion of literature and the growing taste for the best kind of reading has had much to do in the mental guidance and social attitude of the railroad men of today. Superadded to a closer interchange of experience among themselves, and a kindler feeling toward those who by accident or merit may be placed over them, the philosophical spirit that comes from wide reading and a broad knowledge of men and affairs has led them, and will continue to lead them, to a nobler life, with its consequent capacity for a fuller accomplishment of the work that is expected of them.

Electrification of Railways.

The daily press, which is supposed to represent public opinion, contains a vast volume of fallacies concerning the prospects of electrifying all the steam railways in the country. Whenever complaints are made about the nuisance of smoke from locomotives, the cry is raised why don't they make the use of electric locomotives universal? Ignorance declares that electric motive power could be operated as cheaply as steam locomotives and that the benefit to the people would be beyond computation.

The discussion of this question has recently been properly done by an expert, in the person of Mr. D. F. Crawford, superintendent of motive power of the Pennsylvania Lines, who says:

"The word 'electrification' seems to be attractive to every one save those charged with the responsibility of obtaining the money required to meet the enormous outlay of capital required to install the apparatus and then to continue the operation at rates for carrying passengers and freight which will be deemed reasonable to the patrons, as it has not been demonstrated that electrification will generally result in reduced operating costs."

Mr. Crawford writes about the popular belief that the locomotive is a tremendously wasteful engine and that immense saving could be effected by the use of engines that would supply power at much lower cost, but he says as a matter of fact the performance of the locomotive boiler compares favorably with the average results obtained in stationary practice, and the performance of the complete locomotive, of modern construction, is sufficiently efficient to permit of obtaining a coal rate of 2.1 pounds per indicated horse power, or 2.5 pounds of coal per horse power delivered at the drawbar. The advocates of electrification of railways assert that the superior economy of the engines used to generate electricity would produce the electric power almost at the cost of locomotive power which is a fallacy, for few of the automatic engines used in driving dynamos develop a horse power on less fuel than that used by a first class locomotive.

The cost of everything electric is enormous continued Mr. Crawford. The cost of the electric locomotive is at least double that of the steam locomotive, which they are expected to replace, and before electric locomotives can be operated it is necessary to incur a large additional outlay for power houses, transmission systems, track preparation and all of the other apparatus and material which is necessary to complete an electric system. A reliable estimate states that it would cost about $200,000 for each steam locomotive displaced or about ten times the cost of each of the latter.

As there are about 70,000 locomotives in the United States, representing an investment of about one billion four hundred million dollars, it would require some exceptionally favorable return to justify a change involving such a stupendous volume of capital. The people who demand radical changes on existing methods of transportation never count the cost. That is a detail beyond their consideration. Their method of reasoning is—steam locomotives cause a smoke nuisance, therefore they ought to be abolished and the clean electric locomotives put in their place.

Those who are familiar with what the steam locomotive has done for the American people, are not howling to have it sent to the scrap heap. In less than three-quarters of a century the operation of the locomotive has changed a vast wilderness on the American Continent from gloomy, untrodden forests, dismal swamps, and pathless prairies into the abodes of high civilization. Prosperous States, teeming with populous towns, fertile farms and blooming gardens, adjuncts of comfortable homes, have arisen in regions where formerly savage men and wild animals were the sole representatives of life.

This miraculous change has been effected with constant consideration for the people's best interests. The American locomotive has been developed under such influences, that it enables railway managers to transport passengers and

freight at lower cost than the railways in any other part of the world and the people at large enjoy the benefits. Don't be too precipitate in banishing the steam locomotive.

Making of Engineers.

The locomotive engine which reaches nearest to perfection is one which performs the greatest amount of work at the least cost for fuel, lubricants, wear and tear of machinery, and of the track traversed. The nearest approach to perfection in an engineer is having the attributes that enable him to develop the best capabilities of the engine at the least cost.

There are great differences in locomotives, some having serious construction faults that lead to waste in operation, while others are as nearly perfect as skill and knowledge on the part of designer and builder can make them. Similar differences exist among engineers. One man may have charge of a locomotive only a few months and yet exhibit thorough knowledge of his business, displaying sagacity resembling instinct concerning the treatment necessary to secure the best performance from the engine; another man, who appears equally intelligent on matters not pertaining to the locomotive, never develops a thorough understanding of the machine.

A man who possesses the natural gifts necessary for the making of a first-class engineer will advance more rapidly in acquiring mastery of the business than does one whom Nature intended for a preacher or trackman. But there is no royal road to the knowledge and skill requisite for making a first-class engineer. The capability of handling a locomotive can be acquired by a few months' practice. Opening the throttle and moving the engine at the speed necessary require but little skill; there is no engineering accomplishment in adjusting a wedge or in tightening loose nuts; but the magazine of practical knowledge which teaches an engineer to read the voice of the engine's working and enables him to meet every emergency with calmness and promptitude, is obtained only by years in the cab, and by assiduous observation while there. There are two attributes that greatly help in the making of a first-class engineer. They are habits of observation and good judgment, more especially the latter. The most serious defect with men who have failed as engineers has been want of good judgment.

It used to be that there was prejudice among enginemen against reading or studying books relating to their business; but the practice of examining men before admitting them to promotion has to a great extent eliminated that promoter of ignorance. The knowledge derived from books which the other practical man used to despise, contain in condensed form the experiences and discoveries that have been acquired from the hardest workers and most intelligent thinkers of past ages. The product of long years of toilful experiments, where intense thought has furrowed expansive brows, and weary watching has whitened raven locks, is often recorded in a few pages. A mechanical fact which experimenters have spent years in discovering and elucidating can be learned and tested by a student in as many hours. When you hear a man depreciating book knowledge, make your mind up that he is an ignoramus. Such people are still to be found operating locomotives, the more's the pity, but they are every year becoming fewer in number.

Too Many Holidays.

The State of New York has ten legal holidays which require the leading offices and factories to be closed. The legislators who establish legal holidays think nothing about the hardships they inflict upon thousands of work people depending for their bare livelihood upon each day's wages. It is a well-known fact that every day's wages deducted from certain workers means the taking away of meals. While legislators and others are enjoying the leisure given by suspending work on so-called holidays, others less fortunate have to endure hunger to pay for the leisure given. In some shops and factories there is fierce indignation manifested among the employees, as every uncalled for holiday is announced. It is a pity that the people injured by useless holidays do not combine to defeat the legislators who vote for increasing the number of holidays. That is the only way to teach legislators their duty towards their hard-worked constituents.

Scranton Correspondence School.

It is interesting to note from a circular letter issued from the railway department of the International, Correspondence Schools, Scranton, Pa., the steady growth in the number of students who avail themselves of the excellent system of education in all departments of railway service conducted by the institution. Last season showed an increase of ten per cent. over that of the previous year, and during the last quarter from June to September of the present year, an increase of seventeen per cent. is shown, as compared with the same months last year. An evidence of the vast amount of work done in the railway department alone may be gathered from the fact that during the first week in September of the present year, there were 20,180 lessons corrected by the various experts and letters of instruction were written by the experts to 3,134 students. During the first week of October, 26,520 lessons were corrected and 4,169 letters of instruction written during the same week. It may be added that there are no less than forty-nine different sections in the railway department, all of which have special courses of instruction under the supervision of teachers of thorough training and experience.

Peculiarities of Steam Making in Locomotive Boilers.

General knowledge is so inexact that few of the men engaged in the operation of locomotives know with any degree of certainty the cost of operating a single locomotive with the quantity of coal and water used up in keeping up steam.

From a paper prepared by Mr. D. F. Crawford of the Pennsylvania Railroad we learn that to obtain for the modern locomotive the average power required for ordinary train hauling, it is necessary to consume fuel at the rate of about 100 pounds of coal each hour per square foot of grate area; and to obtain the maximum power required it is necessary to burn 150 pounds and at times more than that per square foot of grate per hour. To obtain the power necessary to perform the work of train hauling, a boiler which from its heating surface would be rated at 320 horsepower, is frequently forced to develop over 1,500 horsepower, and records show that another boiler which would on the basis of heating surface be rated at 400 horsepower developed as high as 1,994 horsepower.

The performance stated would require coal consumption at the rate of 60,000 to 10,000 pounds of coal per hour, as it was done on 55 square feet of grate.

In a report submitted to the last American Railway Master Convention by the Pennsylvania Railroad Company the record of tests made indicated that when 7,000 pounds of coal were fired per hour the maximum evaporation efficiency was reached. The draft was stimulated so that 8,000 pounds of coal per hour was burned, but it gave no increase in the evaporation.

The efficient absorption of heat in the boiler is not so difficult to provide for as the efficient combustion of coal, especially at the higher rate of firing, and the limit of combustion on the grate is due to the difficulty of supplying sufficient air to the fuel. A large excess of air is easily obtained, but the real difficulty is to distribute the air through the burning coal. It was observed that when forced to high rates of combustion the fire door must be open to give the maximum evaporation. When it was closed there was an immediate drop in the steam pressure. This will be a new idea to most enginemen that an engine will steam most freely with the fire door open.

During these tests the fire box temperature ranged from 2,000 to 2,400 degrees, while that of the tube ends was from 1,370 to 1,620. There was a rapid decrease in temperature for a distance of 3 or 4 feet in the tube, after which the temperature drop was much more gradual, but it follows the rate of firing; while the fire box and the smoke box temperature increases as the rate of firing increases. The tests indicated that the temperature of all the flues was about uniform.

Prentice System of Wireless Train Control.

The *Railway Engineer*, of London, England, reports favorably on the Prentice wireless automatic control, which has been installed on the Hampton Court Branch of the London and South Western Railway. As originally explained in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING in the issue of March, 1912, in this system the track is divided into a number of insulated sections, in each of which a low voltage track circuit is arranged, with, in addition, a high-tension wave wire running between the rails. At the end of each section is a box containing the high-frequency plant for the supply of current at 20,000 volts to the wave wire.

This plant is controlled by a relay in connection with the track circuit of the section ahead, with the result that if that track circuit be short circuited, the controlling relay is de-energized, and the supply of high-tension current to the wave wire ceases. The locomotive is fitted underneath with an arrangement of wires equivalent to the antennae of the ordinary wireless apparatus. These receive the energy transmitted from the wave wire. and by means of a system of coherers and relays in the cab, a green "line-clear" signal is provided for the driver if the section ahead is unoccupied. If, however, the section ahead be short circuited, the wave discharge and a red light is shown and a buzzer simultaneously sounded, while the brake is at the same time applied, these operations being effected by power obtained from a battery in the cab. Provision is made to enable the driver to release his brake, but the red light and the buzzer continue until the section ahead is cleared, when the high frequency supply is re-established and normal working is resumed.

The system, therefore, provides for a continuous danger signal on the locomotive so long as the line is not clear, the automatic application of the brake and a prompt intimation of the restoration of line clear conditions. In the event of failure of the high tension, or the track circuit, danger indications would be given. The operation of the cab apparatus naturally depends on uninterrupted battery supply. The demonstration was quite successful, the train being brought up on every trial by the automatically applied brake, although the regulator was untouched.

Zeal for Railroad Legislation.

The New York, New Haven & Hartford people, under the new management, have organized a publicity department which, under the management of E. G. Riggs, is sending out information bound to be highly interesting to the American public. One of the most important bulletins is that relating to what the legislators of the various states are doing. All persons who pay any attention to politics are aware that pernicious activity prevails in nearly all state legislature halls, but particulars collected by experts are necessary to portray the extent of the law-making evil.

In the forty-two state legislatures in session since January of this year there were introduced 1,395 bills affecting the operation of railroads. Of these bills 230 have become laws. On the subject of locomotive headlights alone 36 bills were introduced and 14 of them converted into laws. The interests of railroad employees have led to the introduction of 426 measures, 48 of them becoming laws.

President Howard Elliott of the New York, New Haven & Hartford Railroad, speaking recently on the prevailing zeal for enacting laws affecting railroads, said: "It may be said that in the matter of legislation the railroads suffer in common with all other enterprises and with every individual in the country from the American passion for legislation. How profound that passion is can be gathered from a comparison between the legislation introduced into and passed by the English Parliament and by our national Senate and house. At Westminster during the ten years ending with 1909 there were introduced and considered 6,251 measures, of which 3,882 became law; at Washington during the same period there were considered 146,471 different bills, of which no less than 16,000 became law."

Wonders from Pressure.

The simple application of pressure, provided it is powerful enough, is making chemists open their eyes. The behavior of chemical substances under high pressures is in some cases entirely different from the ordinarily observed. Under such pressures, salts decompose spontaneously into their component acids and metals, water yields its elementary gases, and peat consolidates into coal. Says *Energy:*

"The application of very high pressures seems to be producing a positive revolution in the chemical industry. Only a short time ago, the report circulated that Haber had succeeded in causing elementary nitrogen and hydrogen to react at a pressure of 300 atmospheres and at temperatures varying between 900 and 1,080 degrees. A remarkable reaction belonging to this category was likewise discovered by Ipatiew, who succeeded in precipitating metals from their salt solutions by hydration under high pressure. Thus, starting with cupric sulphate, he obtained finely distributed copper and sulphuric acid. There is another interesting reaction in the decomposition of water under high pressure and at high temperatures in the presence of a metal, as, for instance, iron, which binds the oxygen separated. At the same time, hydrogen of very high purity is yielded. This method of producing pure hydrogen is of especial interest at the present time, since this gas is used for many technical purposes in various departments. Among the various modes of production that have been announced of late, the new method is probably the cheapest. The production of artificial coal under high pressure is also one of the recent inventions. Cellulose or peat is heated up with water to 612 degrees under a pressure of more than 100 atmospheres in apparatus especially constructed for the purpose, the resultant being a product identical with mineral coal, both from a physical and a chemical point of view. At 558 degrees the process requires eighty hours, at 612 degrees only eight hours are necessary for the transformation."

Railway Patents.

We look through the *Patent Office Gazette* weekly and are surprised at the number of inventions patented for the improvement of the locomotive and how few of them ever come into use. Most of the devices patented as useful improvements for railway rolling stock are impracticable for the purpose aimed at. Nearly all of them are devised by people who have no acquaintance with practical railway operation. When the excitement for inventing car couplers was in vogue years ago, the greater number of the patentees of automatic couplers were farmers who devoted their leisure hours in winter to inventing car couplers and many wonderful abortions were offered to railway companies. Other lines of invention have now come to the front, but the same class of amateur inventors are laboring to supply needs for railways when no such needs exist.

Tempering Hammer Heads.

Take good tool-steel, do not overheat nor work when black-hot, anneal and finish, heat slowly on rod placed in eye, lay rod on water-trough edge and by revolving same cool ends alternately, commencing at peen, never allowing eye parts into water till black-hot, when cooling-out can take place.—*English Mechanic.*

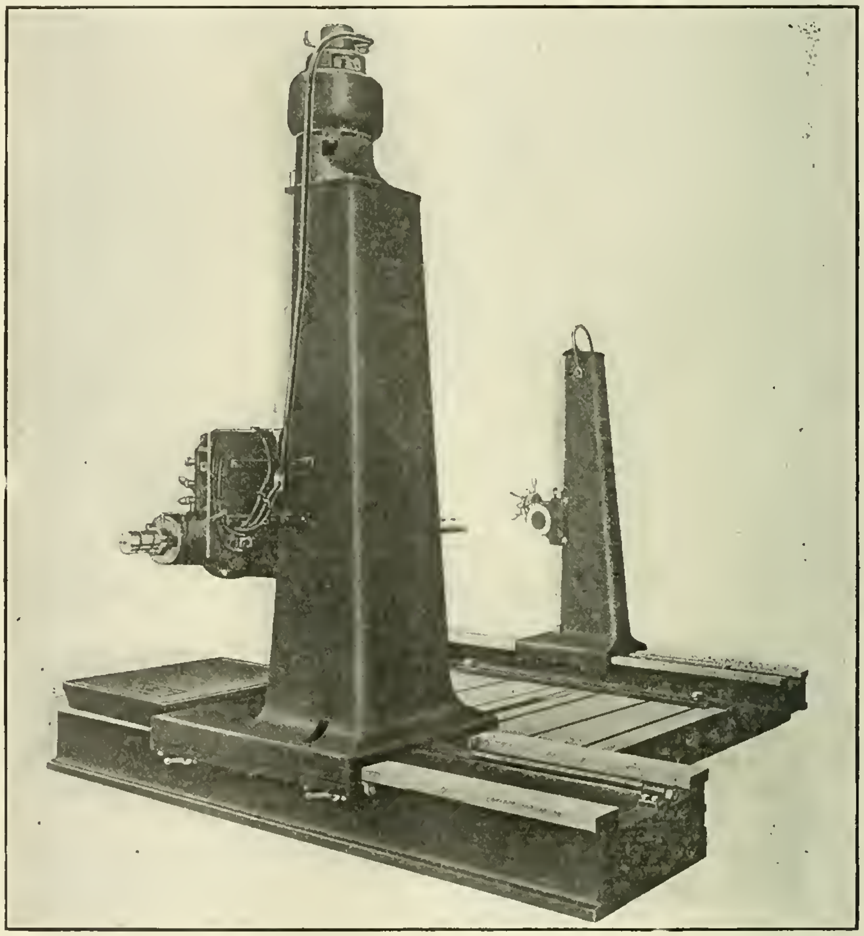
General Foremen's Department

Rochester Floor Type Boring, Milling, Drilling and Tapping Machines.

The Rochester Boring Machine Company, Rochester, N. Y., are achieving well-deserved success in the introduction of a new type of machine on which boring, milling, drilling, tapping, splining, oil grooving and rotary planing can all be done at one settirg, and with swiveling table the different sides of the work can be finished complete. As is shown in the accompanying illustrations the motor is mounted on the top of the column, and is thereby free from chips or other substances, and drives, through rawhide gearing, the vertical shaft which transmits power to the driving mechanism enclosed in the saddle. A multiplicity of gears is avoided, and a very high efficiency of power transmission is obtained.

The saddle consists of a complete unit, and is counterbalanced by weight and every part is readily accessible. All levers and handwheels for changing speed, feed and traverses are all unusually convenient. As will be observed the column is very heavy with long and wide base, and is perfectly rigid in all directions, and is readily adjustable along the bed either by hand or power to any desired position. Binders are arranged for clamping in any position. The spindle is of hammered crucible steel and journaled in long taper bearings of phosphor bronze and located far apart, giving very rigid support. The feed and drive are applied centrally between the bearings. The spindle may be furnished any desired length and the full traverse is obtained without resetting. The method of feeding is through a long bronze nut engaging a square thread in a spindle. The end thrust in either direction acts directly on ball bearings of large diameter. The principle of rotating and feeding the spindle thorough its own bearings gives a lapping motion, and eliminates the scoring or cutting which is found in nearly all spindles that reciprocate but do not rotate in their sleeves, and between which no clearance is provided or adjustment for wear.

A very wide range of feeds and speeds are provided. Vertical milling feeds are provided for the saddle, and horizontal milling feeds for the column independent of the boring feeds. All feeds are reversible, and any desired change can be instantly obtained. The range of speeds can be readily changed to meet special requirements. So perfectly adapted is the fine machine to exact work that graduated scales with verniers reading to thousandths of an inch are arranged for quick reading, for locating the saddle and column in desired position. The outer support and column are also furnished with scales and verniers giving the same readings. A direct reading dial is given for the spindle, and nothing could surpass the degree of exactitude with which the machine is adapted for the laying out of work. A complete self-oiling system provides lubrication for the driving and feeding mechanism of the machine.



BORING, MILLING, DRILLING AND TAPPING MACHINE. FLOOR TYPE—REAR VIEW.

Babbitting a Journal Box.

In relining a journal-bearing with soft metal, the old babbitt should be entirely removed, either by chipping it out with a cold chisel or melting it over a fire. Chipping is a slow method, but, in some cases it is preferable. To chip the babbitt out of a bearing, procure a narrow cape chisel, say ¼-in. to ⅜-in. wide. Then cut through the babbitt lengthwise of the box, right down through the middle. Don't try to get under the babbitt, and drive out the entire thickness of the babbitt at one cutting. Instead of that, drive out a chip nearly ⅛-in. thick. Then go over it again, and get another eighth, and unless the babbitt is very thick indeed, the second cut will bring the groove down to the cast iron. After the groove is cut, it is very easy to drive the chisel under the babbitt, first at one corner then another, gradually loosening it, and tearing the half lining bodily from the journal-bearing or cap, as the case may be. In very long bearings, it may be necessary to cut a cross-groove midway between the ends; but usually a groove lengthwise down the center will answer every purpose.

When babbitt is to be melted out instead of chipped out, procure a large iron pot. A kettle is not as good. An old-fashioned

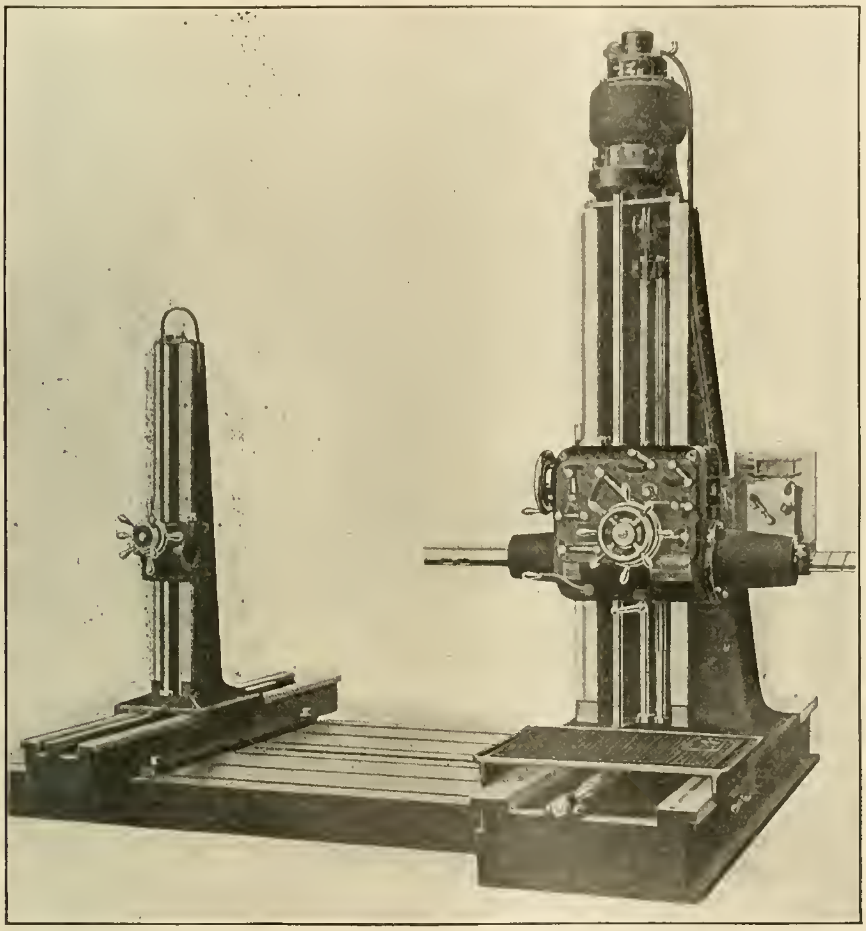
pot, made round at the bottom, with three short legs, and without the jog with which kettles are fitted should be suspended over the forge or other fire used for the purpose, and should not be placed directly upon the coal. Hang up the pot an inch or two above the fire. Then there will not be much danger of burning it. Place a few pounds of babbitt metal in the bottom of the pot. Heat slowly and carefully, hot enough to melt the babbitt, but not hot enough to make the pot red-hot.

As soon as the babbitt is melted, place in the pot the bearing or bearings from which the babbitt is to be removed. You can put in as many as the pot will hold if you have that many to do. Just pack them in as closely as possible, placing them on end, one end resting in the babbitt in the pot, and the other end of each bearing extending up. Let the fire be kept steady, not hot enough to make the pot red-hot, but hot enough to keep the babbitt in a very fluid condition. If the job is to be hurried, a cover placed over the pot—a piece of tin or sheet iron—will keep in considerable heat and cause the melting-out to take place several minutes quicker than when the pot is left uncovered.

Don't try to keep the melted babbitt metal clean: no matter if there is dirt, coal, and other refuse on the surface. Let such dirt stay there. This is for the purpose of preventing oxidation of the babbitt metal. Oxidation causes a lot of dross to form, and uses up a corresponding weight of babbitt metal, which could be saved by covering the top of the babbitt with any substance which will prevent air from reaching the babbitt.

Just before the babbitt melts from the bearings, retard the fire a little, for very little more heat will be required, and none after the babbitt is once melted. Babbitt should never be heated too hot. When at a red-heat, it oxidizes readily, and a large percentage goes off in gas, which is turned into dross. The old-time rule for heating babbitt—to heat it just hot enough to char or blacken the surface of a newly-dressed pine-stick.

There is one exception, however, to this rule. When bearings are to be poured, especially steel bearings, where there is a very thin form of soft metal between shaft and casting, then it is necessary to heat the babbitt hotter than is required when a considerable thickness of bearing is to be poured. In pouring thin linings, it is also necessary to heat the boxes, and, incidentally, to heat the shafting as well. Let both be heated so hot, that water will sizzle when thrown upon them. This being done, there is usually little trouble in pouring perfect boxes.



BORING, MILLING, DRILLING AND TAPPING MACHINE. FLOOR TYPE—FRONT VIEW.

Case Hardening.

At the Master Blacksmiths' Association Convention the method of case hardening submitted by Mr. George Massar was generally approved. A double-deck furnace should be especially designed for spring work and case hardening. Cast iron boxes and lids should be used. The pieces to be hardened are packed carefully with a compound consisting of 2½ per cent. Bichromate potash, 5 per cent. Pruss potash, 10 per cent. common salt thoroughly pulverized and well mixed. The edges of the lid should be closed as tightly as possible with fire clay. The box should be allowed to remain in the furnace from eight to ten hours at about 1,600 degrees Fahr. Good results cannot be obtained with a heat that is not uniform. If the heat is too low, satisfactory carbonization cannot take place. A deep case hardening can be obtained in a short time by rushing the heat until the box is heated thoroughly, and then drop to the carbonizing heat. On removing box from the furnace quench the articles in clear, cold water a salt brine. The cooling trough should be of good size, allowing water to flow in at bottom of trough and flowing out at top, so as to keep water cool. Case hardening material must not only contain carbon, but it must be of such quality that the carbon will not be released in its gaseous form until the metal is of sufficiently high heat to absorb it.

The First Diesel Locomotive.

The completion of the first main line internal combustion locomotive is regarded by many as an event of importance in internal engine circles. The engine was ordered by the Prusso-Hessian State Railway. Most other internal combustion locomotives that have been constructed have either transmitted the power to the wheels through gearing or have used some kind of automixe system in which the engine is used to drive a dynamo, which in its turn works motors on the axles. In this case the connecting rods of the main engine act directly on two cranks on an intermediate crankshaft. These work the driving wheels by outside connecting rods, a similar arrangement to that now generally employed on many large electric locomotives.

Loose Babbitt.

In fastening loose babbitt in bearings it is sometimes accomplished by using screws, but care should be taken that the screws are not made of hard metal.

Either copper or brass rods threaded and screwed in as tightly as possible, and after cutting off the screw the end may be riveted into a countersunk hole in the babbitt. They will remain tight when the bearing warms up the effect is to aid in tightening the babbitt.

Air Brake Department

Electro-Pneumatic Brakes.

In past issues we have commented upon the electric transmission of the operator's intent as applied to the operation of an air brake system, and at the present time it is desired to continue on from the devolpment of the L. G. triple valve to a state of pneumatic perfection of the brake before electric attachments should be considered. If the reader first learns of the objects sought in the development of the universal valve for passenger cars, it will be comparatively easy to then learn from a diagrammatic view, how and why the various parts and their actions are necessary.

As noted in connection with the L. G. triple valve some very necessary features of type L triple valve were improved upon and the control valve of P. C. equipment is a further improvement upon the L. G. valve, and makes possible the use of two brake cylinders per car with one or a single operating valve and, permits of a very wide difference between service and emergency braking power.

The universal valve now represents a perfection of the pneumatic features of the brake which can be operated either pneumatically or electrically, and as previously stated electric operation cannot become a necessity until pneumatic efficiency reaches the highest possible state.

Electric transmission first became a necessity on the Interborough subways in New York City when an increase of speed from 40 to 60 miles per hour was contemplated. Mr. Turner, however, in analyzing the situation pointed out the fact that more time was being consumed between the point of shutting off current and the point of stop than could be gained by an increase in speed, provided the train could be stopped from a 40 mile per hour speed in 350 feet instead of the average of 650 feet that was then necessary, in which to make the stop.

Stopping a 10-car train filled with passengers and without discomfort to them from a speed of 40 miles per hour in 350 feet, or in cases of emergency, in 275 feet distance, is beyond the capacity of any pneumatically operated brake, because it necessitates the most efficient pneumatic brake and an instantaneous application of every brake in the train, and the latter is made possible only through the use of electric current.

The Westinghouse universal common standard brake equipment as applied to steam road passenger trains is distinctly the result of and made necessary by present day steam road conditions and requirements. The more important factors which have combined to demand a brake of greater efficiency are:

1. Very heavy cars and long trains which increase the energy to be dissipated in bringing the train to a stop.

2. High schedule speeds which, in connection with heavy cars, emphasize the necessity of very high emergency braking power and the importance of securing maximum braking power *immediately*.

3. The gradual but continued introduction of factors which tend to reduce brake efficiency, such as heavier foundation brake rigging, excessive fake travel, stronger release springs, greater leakage from larger cylinders and longer trains, and a reduced mean coefficient of friction between the brake shoe and the wheel as affected by speed, time of stop, and brake shoe pressure per square inch, all demanding an improved passenger brake which will, so far as possible, reduce or compensate for these losses.

In brief, the rapid development in recent years in weights of cars, speeds, traffic, equipment and requirements has imposed conditions which the type of brake which was adequate for past conditions has been unable to meet in a manner satisfactory to railroad officials.

Briefly stated, the requirements recognized as essential in a satisfactory brake for this modern service are as follows:

1. Automatic in action.

2. Certainty and uniformity of service operation.

3. Maximum predetermined and fixed flexibility for service operation.

4. Maximum sensitiveness to release, consistent with stability, combined with minimum *sensitiveness* to the inevitable fluctuations of brake pipe pressure, tending to cause undesired light service applications, brakes creeping on, etc.

5. Brake application instantaneous throughout train.

6. Maximum protection against complete loss of the brake due to failure of any part of the system.

7. Quick recharge and consequent ready response of the brakes to any brake pipe reduction made at any time.

8. Graduated release.

9. Predetermined and maximum practicable difference between service and emergency braking power.

10. Full emergency pressure obtainable at any time after a service application.

11. Full emergency pressure applied automatically when a predetermined brake pipe reduction is made after equalization.

12. Full emergency pressure applied automatically in case the brake pipe pressure is depleted below a predetermined danger point due to leakage, or any other cause.

13. Emergency brake cylinder pressure maintained without blow down throughout stop.

14. Emergency braking power approximately 100 per cent. greater than the maximum obtainable in service applications.

15. Maximum brake cylinder pressure obtained in the shortest possible time on the train as a whole as well as on individual cars.

In the development of a brake to satisfy the above requirements, it became evident at once that the fundamental functions of the ordinary quick action automatic air brake would have to be supplemented by a number of novel functions, some of which could be secured to the necessary degree only by the addition of an electric control to the pneumatic portion of the brake apparatus. These considerations led to the development of the equipment known as the Westinghouse universal common standard electro-pneumatic brake equipment for steam road service, employing what is known as the type U universal valve in the place of a triple valve and consisting of a combination of the most improved form of pneumatic brake with electric control of both service and emergency operations.

Railroad men have noted the increased capacity of the subways due to the use of the electro-pneumatic brake, and as a result the Pennsylvania Railroad has equipped several hundred cars with the type U universal valve which operates practically the same pneumatically or electrically.

Obviously any railroad equipment must operate in perfect harmony with any or all previous types of air brakes, therefore a reduction of pressure must cause it to apply and a restoration of pressure to effect a release.

It will be understood that the electric portions adds no braking power beyond that obtained through instantaneous action, but by its use the application of every brake, either in service or emergency, starts with the instant the brake valve handle is moved to the proper position and the opening of each brake cylinder exhaust port for releasing occurs at the same instant or can be instantly

opened or closed at will by movements of the brake valve handle which thus provides a perfect graduation of release.

Both features are operatively interlocked, the movements of the brake valve handle being the same for electric and pneumatic operation. When operated electrically the application occurs from brake pipe reductions at each universal valve before the brake valve can reduce brake pipe pressure, consequently any failure of the electric portion could not affect the pneumatic portion, which provides the necessary factor of safety.

to both service and emergency features, or to service alone or to emergency only. Applied to emergency it means an increased factor of safety; to service, smoothness of stop and a reduction in time required to make stops, and applied to both the instantaneous and simultaneous response and uniform application reduces the human equation relating to manipulation to a minimum.

It is generally understood by air brake men that before electric operation should be considered, the pneumatic brake should be designed to permit the greatest possible

merely to associate electric control with the improvements of pneumatic features.

In the design of this valve it was desired to eliminate, so far as possible, all of the undesirable features of all former equipments and improve the desired to the highest possible degree. All disorders of triple valves and locomotive equipment were carefully considered and that which has been accomplished will be of interest to every air brake man.

First the undesired quick action with its 42 contributing causes so frequently working in odd combinations is entirely

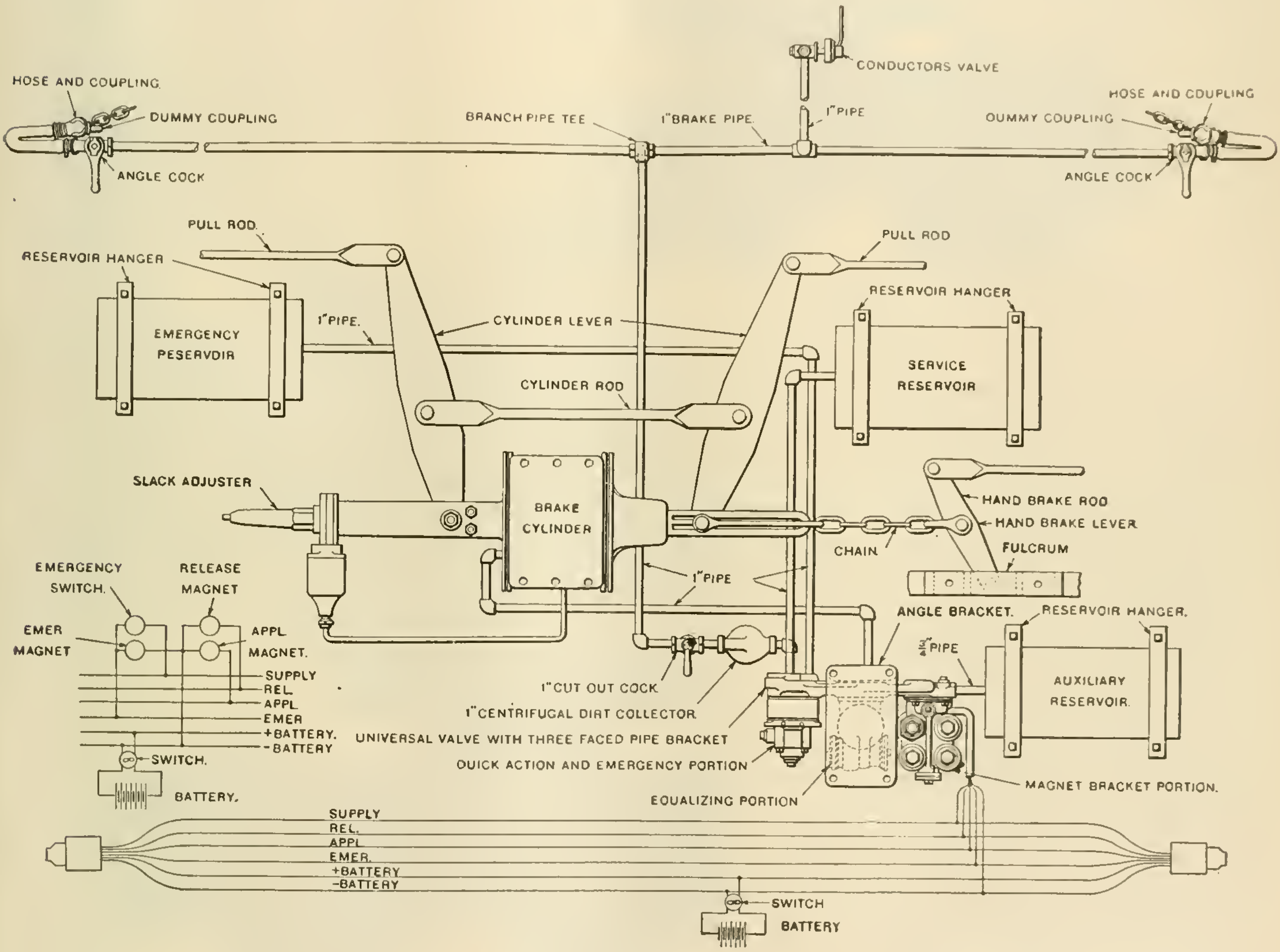


FIG. 1. UNIVERSAL COMMON STANDARD ELECTRO-PNEUMATIC BRAKE EQUIPMENT. (SINGLE BRAKE CYLINDER PER CAR.)

In release position, main reservoir pressure from the locomotive returns the movable portions of the universal valves to release position, while the electric portion prevents the exhaust of brake cylinder pressure until running position of the brake valve is used. In holding position of the brake valve the escape of brake cylinder pressure is also prevented, and when running position is reached a drop in pressure from all cylinders occurs instantly.

Electric operation can thus be applied

difference in time between the attainment of full cylinder pressures in service and emergency. Assumed that rate of service application is high as practicable and the difference in force should be at least 100 per cent., or double braking power for emergencies, also that emergency application be more quickly obtained, more powerful and obtainable at any time.

While electric transmission has been added to triple and control valves, it is desired to deal only with the development of the universal valve. The digression is

eliminated so far as service operation is concerned in that service, and emergency features are entirely separated, the service or equalizing and the emergency portions being on opposite sides of a bracket. While there is a very remote possibility of quick action during service operation it cannot occur through any neglect of the locomotive equipment or of the service parts of the universal valve.

The "creeping on" of brakes due to leakage or slight overcharges from defective feed valves is also eliminated by

the construction of the equalizing portion which is extremely sensitive to movement at the predetermined time or toward release position when desired, but will not apply with less than a definite reduction of brake pipe pressure.

The trouble caused by brakes sticking, due to the slow rise in brake pipe pressure on long trains is overcome by the universal valve as the auxiliary reservoir is recharged from the emergency reservoir and the service reservoir is cut off from both reservoirs until brake pipe pressure is raised to nearly the maximum carried. The maximum sensitiveness to release is further augmented by an automatic bleeding or venting of auxiliary reservoir pressure, thus it is only necessary to supply the actual brake pipe volume during release and with this increase the brake bleeds itself off and recharge occurs after the release is effected.

This feature will be appreciated by those who have been operating or caring for the double P. M. and double L. N. equipments where in nearly all cases the volume of compressed air required to release brakes is so great that stuck brakes are a rule rather than an exception.

Those troubles are not merely due to defective mechanism, but with the double L. N. brake the first two cars of four auxiliary and four supplementary reservoirs can absorb brake pipe pressure as fast as the feed valve can deliver it, or as fast for the time being as an 11-inch compressor can supply it, hence brakes sticking on rear cars is but a natural consequence.

The graduated release and quick recharge feature of the universal valve, accomplished by the use of emergency reservoir pressure, not only adds to the flexible control of the brakes, but insures a factor of safety as the inherent operation is such that the brakes must either be applied or the system must be recharging for another application.

By flexible control it is meant that the brake is promptly bent to the will of the operator. With former equipments considerable time elapses between the time of application of all brakes in a train, and the time that must elapse between release and recharge for another application is usually reckoned in minutes in which air pump and main reservoir capacity are prominent factors, hence the triple valve equipments may be said to be rigid or hard to handle, while the universal valve provides the maximum degree of flexibility in that any number of cars are operated as a single car and locomotive, and require but a minimum amount of skill and judgment upon the part of the engineer.

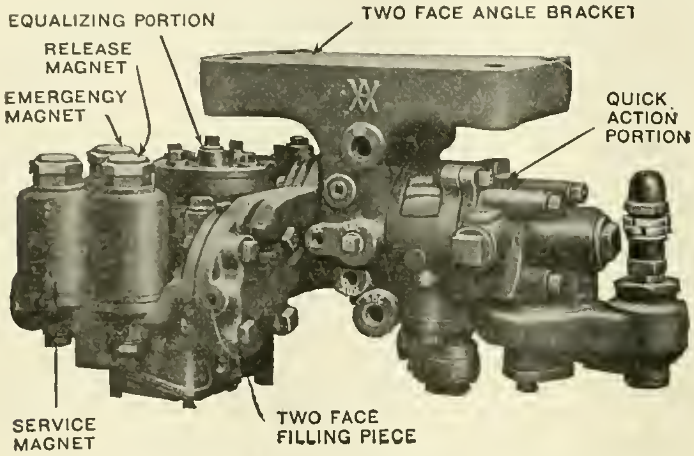


FIG. 2. TYPE U COMMON STANDARD UNIVERSAL VALVE.

During release and recharge the air delivered to the brake pipe is all effective in raising its pressure and the auxiliary must charge from the emergency reservoir at the same rate.

Another important feature is automatic emergency upon a depletion of brake pipe pressure. Should the brake be applied and the handle forgotten in lap position, leakage might eventually reduce brake pipe pressure to a predetermined point, whereupon an emergency application will automatically occur, which makes the brake almost absolutely self operating.

Full emergency braking power can be obtained at any time, regardless of previous service applications, as service and emergency features are separated, emergency applications can only be caused by a sudden drop of 6 or 8 pounds per second in brake pipe pressure which must necessarily be done with emergency position of the brake valve, an open conductor's valve, a ruptured brake pipe or a lowering of pressure below the tension of a protection valve spring.

Transmission of quick action is accomplished by each universal valve venting brake pipe pressure to the atmosphere, and while service cylinder pressures are limited by safety valves, full emergency pressures are held to the stop. With two cylinder equipments (one for service and both for emergency) a safety valve is unnecessary, as braking power is then based on an 86-pound cylinder pressure.

With a single cylinder equipment the desired emergency action is obtained through the combined action of an emergency piston and slide valve, a high pressure valve, a cut off valve and an intercepting valve.

The universal valve shown has three distinct portions, equalizing or service, emergency and electric mounted on an angle bracket with suitable faces for attachment.

The different portions are named in the illustrations, the equalizing portion which performs the work of a plain triple valve is directly affected by the reductions and restoration of brake pipe pressure, and it controls directly and indirectly with other parts of the universal valve, the charging of the reservoirs, the application of the brake and the release of the brake.

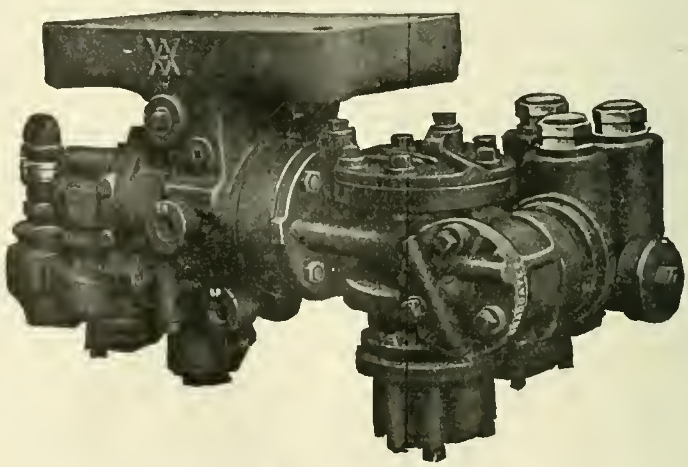


FIG. 3. TYPE U COMMON STANDARD UNIVERSAL VALVE.

The service and auxiliary reservoir combined form the reservoir volume for the brake cylinder in service applications, and the emergency reservoir provides for graduated release, high pressure emergency and recharge of the auxiliary.

It should first be stated that during the transition period, while these universal valves are used among triple valves that

have no graduated release features, it may be desirable to use the universal valve in direct release which is accomplished by turning the graduated release cap which forms a cylinder cover at the end of the release piston.

The proper position of the cap can be determined by noting the words formed by the turning of the cap—the wording will be "direct release" or "graduated release" as desired.

In direct release, the auxiliary reservoir is charged from the brake pipe during a release of the brake, but the service and emergency reservoir are cut off until almost maximum brake pipe pressure is accumulated.

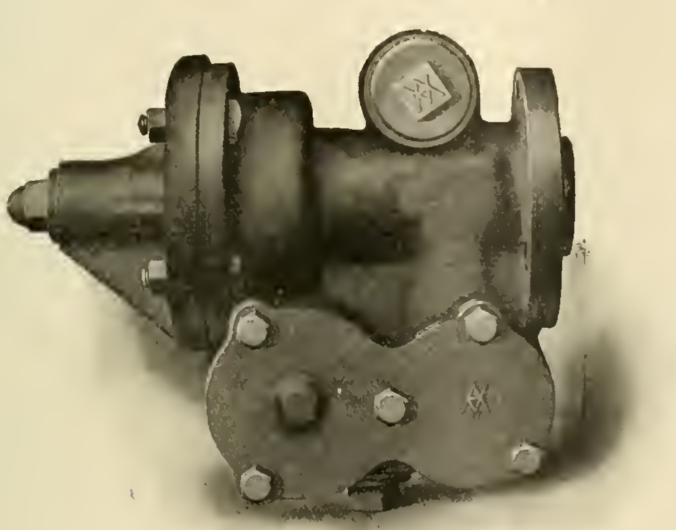
The emergency reservoir has no part in service applications, and during this same transition period it may be considered inadvisable to use the maximum high-pressure emergency on universal equipments when others cars in the train have a very narrow margin between full service and emergency pressures, and in this event a small emergency reservoir is added and a check valve is placed in the pipe leading to the large emergency reservoir.

Thus in direct release the brake cylinder pressure exhausts straight away as with the ordinary triple valve, but in graduated release position the brake cylinder pressure can be partially exhausted and retained at will, and the emergency reservoir charges the auxiliary reservoir up to within a few pounds of maximum pressure with the service reservoir also cut off until all brakes have been released; hence only the brake pipe absorbs main reservoir pressure during release.

This universal valve may be employed for any weight or class of car having a single cylinder, only the size of brake cylinders, service and emergency reservoirs vary with the different schedules.

As available space will not permit of a complete description of the operation of this valve a large diagrammatic view of the portions will be shown and the flow of air during the different operations explained in next month's issue.

As an interesting comparison of the outward appearances of the universal valve and the triple valve, we also have a photographic view of the L. G. triple valve.



L. G. TRIPLE VALVE.

Air Brake Instruction.

What constitutes practical air brake instruction and how and where it should be given, is a subject that has been discussed on the floor of the Air Brake Conventions for several years, and the merits of oral instructions versus practical demonstration have been discussed by the Traveling Engineers; and of course difference of opinion are sure to follow any discussion upon any subject.

The usual methods employed in instructing railroad men in the operation of the air brake, that is, giving the instruction in the class room form, in the instruction car, does not meet with the approval of some of the Traveling Engineers, who seem to think that the instructions should be given in the engine cab, with the instructor handling the brake valve.

The way we see it, the original Westing house style of instruction has not as yet been improved upon to any appreciable extent, and under modern operating conditions the writer has found that the cab of an engine in service is a very poor place to talk air brakes or show how a train can be parted by incorrect manipulation of the brake valve. On the other hand, a class can be formed in the instruction car and they can be taught first, how the air is compressed and how it flows through the equipments, the duties of the various valves and in a general way how they are operated. Then the fundamental principles must be taught before any man can grasp the reasons for the various operations in brake valve manipulation and train handling.

The man must be taught what braking power is based upon, and the almost innumerable conditions under which it is a variable quantity, and he should become familiar with the term percentage of braking power, as it is generally expressed in air brake practice. After he learns to distinguish the actual differences between volume and pressure, the nominal percentage of braking power and the actual retarding effect under a variety of train brake conditions, he will be in a better position to understand the reasons for different brake valve operations.

The class must be taught that the chief consideration in handling the brake valve is the time element, and with various lengths of trains, must know approximately the time that should elapse between the movement of the brake valve to release position and the opening of the engine throttle, or the return to release position after an application and the return to running from release position. Also the time that will elapse between the application of the first and last brake in the train and the time between the release of the first and last brake. The time required to accomplish a release and recharge under various conditions as to previous amount of brake pipe reductions or leakage and the calculation of the effect of various main reservoir volumes and air pump capacities as affecting the required time. To be able to intelligently manipulate a brake valve under modern operating conditions, the class must know the difference in pressure that exists between the two ends of a long brake pipe after various operations, how to take advantage of those differences or neutralize so far as possible their undesirable effects, and above or beyond any doubt, must know how to intelligently estimate the time required to charge the auxiliary reservoirs, from which braking power is obtained, and under the various conditions that are met with from time to time.

We can imagine of no more appropriate place to learn those essential factors than in the instruction room or car; for in order to make the practical demonstrations, that are so apparently desired by some of the Road Foremen, the class must see or be shown, and we know of no better way than to point to the positions of the hands of the auxiliary reservoir gages and the brake pipe gages located at the various points about the train brake equipments in the instruction car. The effects of various brake pipe reductions

is shown by the brake cylinder gages, in fact, the entire train brake operation is brought into compact form in the single car, and just how this matter could be clearly demonstrated to a man in an engine cab is not altogether clear to us. If the student is to become proficient in manipulation from the formation derived from the actual handling of the brake valve alone, the instructor would likely be compelled to make several hundred trips with him until all the possible make-up of trains both in freight and passenger service have been handled.

In the instruction car we have the various lengths of train, various lengths of piston travel at a moment's notice with any amount of leakage that is desirable to show the effects of; in fact, we cannot see anything to the argument save that being compelled to handle a train out on the line of road would tend to prevent the occasional selection of a shop man for the position of instructor.

Outside of knowing the road, a man must have two qualifications to be a successful air brake operator. They are experience and judgment and they cannot be taught, therefore the up-to-date instructor no longer specifies the amount of reduction that should be made with the various make-up and condition of trains, he outlines the contributing factors, demonstrates the variety of conditions that enter the operation, states the desired results and leaves the final conclusions to be the result of the same experience and good judgment.

In instruction car work it is practically impossible to get the student of the air brake to commence his course at the beginning instead of at the middle, the first thing he wishes to learn is the defects of the brake and how to locate them by test, and at the present day we can imagine of nothing of less consequence than an inability to correctly report work to be done. If he will first learn the construction and the operation of the valves he will not have much difficulty in learning to locate the defects when he comes in contact with them.

There is no objection to a man learning all about the brake he wishes to, but some of it may be inclined to be ornamental rather than useful, and with the variety of freight car, passenger car and locomotive equipments that are in use today, it is of a decided advantage to first be concerned with the useful and practical end of the business, which consists chiefly of learning to handle the brakes, how to arrange to bring the train to the terminal in cases of emergency or the failure of any part, especially in cases of broken air pipes on the locomotive or the failure of any of the valves of the locomotive brake.

Locating defects and disorders of the system has ben greatly simplified for the engineer in that the round houses and repair shops employ the best air brake talent that can be secured for the work, hundreds of them make a constant study of the air brake, many contribute to technical publications, and hundreds of others make improvements upon standard valve mechanism and air brake practices, so that if the man reporting the defect has any doubt as to the actual cause of the disorder he need only state briefly, in a general way, how the brake acted, and the chances are that the proper repairs will be made before the engine is again ready to leave.

As to the class of service from which the air brake instructor should be selected, we agree with the remarks of Mr. H. A. Wahlert on this subject during a discussion at one of the air brake conventions, who said in part: "For an air brake instructor we want an air brake man regardless as to where he comes from or who his ancestors were; the greatest air brake instructor I ever knew was a sheep ranchman."

Effect of High Pressures.

Curious and unlooked for manifestations have of late been observed from the application of very high pressure. It used to be considered that heat was the only medium which would separate compound substances into their simple elements, but it has now been found that pressure is equally effective and more convenient in some respects. Salts decompose spontaneously into their component acid and metals, water yields its elementary gases, and heat consolidates into coal.

The application of very high pressures seems to be producing a positive revolution in the chemical industry. Only a short time ago, the report circulated that Haber had succeeded in causing elementary nitrogen and hydrogen to react at a pressure of 300 atmospheres (4,410 pounds) and at temperatures varying between 900 and 1,080 degrees, Fah. A remarkable reaction belonging to this category was likewise discovered by Ipatiew, who succeeded in precipitating metals from their sale solutions by hydration under high pressure. Thus, starting with cupric sulfate, he obtained finely distributed copper and sulfuric acid. There is another interesting reaction in the decomposition of water under high pressure and at high temperatures in the presence of a metal, as, for instance, iron, which binds the oxygen separated. At the same time, hydrogen of very high purity is yielded. This new method of producing pure hydrogen is of especial interest at the present time, since this gas is used for many technical purposes in various departments. Among the various modes of production that have been announced of late, the new method is probably the cheapest. The production of artificial coal under high pressure is also one of the recent inventions. Cellulose or peat is heated up with water to 612 degrees Fahr., under a pressure of more than 100 atmospheres (1,470 pounds) in apparatus especially constructed for the purpose, the resultant being a product identical with mineral coal, both from a physical and a chemical point of view. At 558 degrees, Fahr., the process requires 80 hours, at 612 degrees, Fahr., only 8 hours are necessary for the transformation.

New Haven's New Time Table.

The principle of "safety first" is emphasized in the new time table of the New York, New Haven & Hartford Railroad which went into effect on Sunday, October 5. This new timetable represents the most extensive revision of train schedules that has ever before been attempted at one time. It has been made primarily with the view of promoting safety in the operation of all trains. While the changes in many train schedules will have the effect of lengthening the running time of trains the management believes that this will be in conformance with the wishes of the public in this respect and that it will meet with approval.

Of the two thousand trains which the New Haven Road operates each weekday the changes will affect approximately two-thirds. Those chiefly affected are the through trains and the long distance local trains. Very few changes have had to be made in the case of commuters or suburban trains at New York and Boston, as these trains have been on a standard schedule for some time. The time of the limited trains between New York and Boston has been lengthened ten minutes so that they will now take five hours and ten minutes to cover the distance between the two cities. The average speed of these trains under the new schedule will be 47.8 miles per hour excluding stops. While this is a slight reduction over their former speed these trains will still be surpassed in speed only by two other limited trains operated in the East.

Grease Stains on Steel.

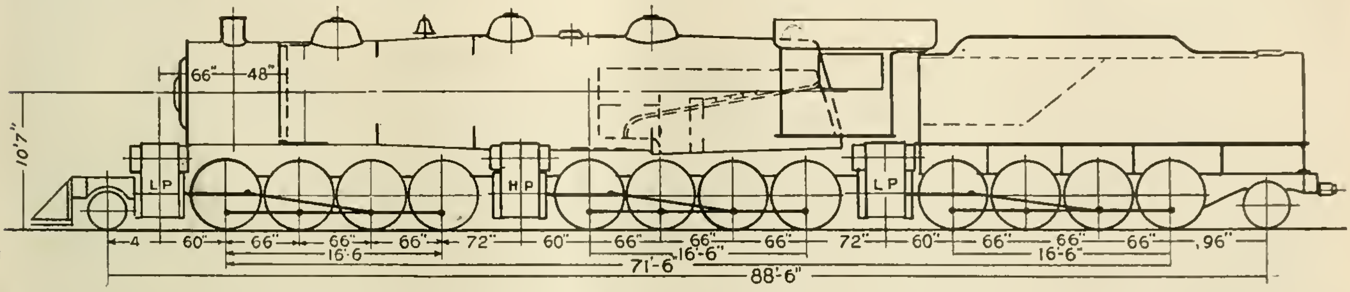
Grease and stains can be removed from steel with a mixture of unslaked lime and chalk powder, by rubbing it on the steel with a dry cloth. The best proportion for the mixture, which is easily prepared, is 1 part of lime to 1 part of chalk powder. The powder should be used dry. It can be kept in cans for future use and can be used over and over again.

Erie Six-Cylinder Mallet Locomotive.

The annexed engraving illustrates the latest development of the locomotive designed for hill climbing by Mr. William Schlafge, mechanical superintendent, and under construction by the Baldwin Locomotive Works of Philadelphia. The engine and tender will weight 800,000 pounds and will develop tractive power of 160,000 pounds. The weight in working order will be 30,000 pounds on truck, 480,000 pounds on one set of driving wheels and 260,000 pounds on the other set, while the trailer will carry 50,000 pounds.

The engine has three sets of cylinders, one high pressure set being 36 inch diameter by 32 inch stroke, the two sets of low pressure cylinders being of similar dimensions. Two sets of low-pressure cylinders are used where one large set is usually employed. The diameter of the driving wheels is 63 inches, with 11 x 13 1/16 journals.

The firebox is of the radial stay type, 162 inches long and 108 inches wide. There are 318 flues 2¼ inches in diameter



SIX-CYLINDERED ARTICULATED MALLET LOCOMOTIVE FOR THE ERIE.

Designed by Wm. Schlafge, Mechanical Superintendent. Baldwin Locomotive Works, Builders.

and 24 feet long, 53 flues 5½ inches in diameter and 24 feet long. The heating surface provided is 310 square feet in the firebox, 4,480 square feet in the 2¼-inch tubes and 1,825 square feet in the 5½-inch flues, combustion chamber 45 square feet, brick arch tubes 40 square feet, total, 6,700 square feet. The grate area 120 x 108 inches is 41 square feet. The superheater has 1,530 square feet. Ratio of grate to heating surface 1 to 163.

The Baker valve motion is used; the Schmidt superheater and the Street mechanical stoker will be applied. A water bottom tank is employed with a capacity of 10,000 gallons and 16 tons of fuel. Weight loaded, 310,000 pounds.

True Straightness Impossible.

One of the most difficult problems in practical mechanics is to make a straight edge. How difficult it is may be judged from an incident that occurred in the shop of a celebrated American astronomical instrument maker. A patron asked what would be the price of "a perfect straight edge of glass 36 inches long." "It cannot be made perfect," said the instrument maker; "but it could probably be made with a limit of error amounting to only a fraction of a wave length of light." "How much would that cost?" "About forty thousand dollars." It turned out that the customer wanted the straight edge for a scraper, and that an error of one-sixty-fourth of an inch would not bother him.

Discovery of Phosphorus.

The great mountains of the American Continent probably contain unmined treasures that will prove of great value to the people when they are brought to practical use. Great areas of land are suffering for want of phosphorus or other stimulating substances which are present in all fertile soils. Hitherto the mountains have been searched principally for precious metals, but miners are now beginning to search for substances which may in the end prove more valuable than gold and silver.

A recent report of the Geological Survey shows that in the Northwest country of Idaho, Wyoming and Utah the United States possesses probably the largest and richest phosphate deposits in the world From surveys recently cast up in totals these deposits show evidences of 267,000,000 tons of high grade phosphate rock, while the chances are that millions more tons may be added to this total before the pay rock is exhausted.

These deposits show the rock in pebble formation, closely cemented in masses and containing some calcite. These round particles vary from a microscopic size to pebbles half an inch in diameter. In color the phosphate rock ranges from a gray to a jet black, the black probably due to carboniferous matter. All public lands suspected of containing valuable deposits of phosphate now are withdrawn from public entry until such time as the value of the deposits is tested, preserving the status of the land until Congress shall take action.

Why Heat Causes Thirst.

In hot weather you notice that you are constantly thirsty. Often you feel that you simply can't get enough to drink. You needn't worry about the feeling. It merely means that the machine of your body is working normally.

This mechanism is driven by a heat engine. The food you eat has a heat value just the same as coal. Its combustion keeps the heat of the body day and night at about 98⅗ degrees. Temperatures in the neighborhood of 100 degrees put something of a strain on the mechanism regulating the heat of the body, for then the body must be cooled below the temperature of the surrounding air. This is done by the sweating process. Evaporation keeps the temperature down.

It can be worked out as a problem in physics that the food eaten in a day by a workman with an average appetite would produce enough heat to evaporate about six quarts of water at the temperature of the body. An English medical officer stationed in India, where the temperature for months at a time does not fall below 100, reports that a daily consumption of about six quarts of water was required for a person taking a considerable amount of exercise.

It is necesssary to drink plenty of water to supply the body with enough material for evaporation to keep cool.

Large Boring and Turning Mill.

A contract has been placed by the United States Navy Department for a 36 ft. boring and turning mill, for use at the Brooklyn Navy Yard, which will be the largest machine of its kind ever built in the United States, and will be used for machining the tracks for warship turrets. The table of the mill will be driven by a gear which is 28 ft. in diameter, the spindle will be 30 ins. in diameter, and the faces of the cross rail and the uprights will measure 4 ft. and 2 ft. respectively. The bed will be 25 ft. wide, the over-all height of the mill will be 27 ft., and the total weight will exceed 600,000 lbs. A 75 horse-power motor will be used to drive the machine.

Give us, oh, give us, the man who sings at his work. Be his occupation what it may he is equal to any of those who follow the same pursuit in silent sullenness. He does more in the same time—he will do it better—he will persevere longer — *Thomas Carlyle.*

Superheater Locomotives for the Louisiana Ry. & Navigation Co.

Heretofore, the majority of superheaters used in locomotive work have been applied to large engines which are operating in heavy service. One important advantage resulting from the use of superheated steam in this class of power, is that, with hand firing, the locomotives can be worked more nearly to the limit of their theoretical capacity, without risk of incurring steam failures, than is possible when using saturated steam.

Superheated steam, however, because of the reduction in fuel and water consumption resulting from its use, is proving highly successful, in comparatively light locomotives, which could readily be hand-fired, and worked to the limit of their capacity, when using saturated steam. The accompanying illustrations show examples of two such locomotives, built by The Baldwin Locomotive Works for the Louisiana Railway and Navigation Co. The Consolidation engine is one of two which were built in the fall of 1912; while the ten-wheeler is one of three engines recently placed in service.

The two designs are generally similar, and interchangeable details have been used where practicable.

The main line of the Louisiana Railway and Navigation Co. extends from Shreveport to New Orleans. It is laid with 70-pound rails, and has grades of 0.4 per cent. and curves of 4 degrees. Under these circumstances, a comparatively heavy tonnage can be handled by relatively light engines. In the case of both types the wheel-loading is conservative for 70-pound rails, as the average weight carried per pair of drivers is less than 20,000 pounds.

The Consolidation type locomotives are used in freight service, and exert a tractive force of 30,600 pounds; while the ten-wheelers exert a tractive force of 26,500 pounds, and are suitable for either passenger or fast freight service. The boilers of both classes are of the extended wagon-top type, with long fire boxes over the frames, and furnace fittings arranged for the use of Illinois bituminous coal. The superheaters are of the Schmidt top-header type, with 22 elements; and the smoke-boxes of both classes are fitted with the Master Mechanics' self-cleaning front end arrangement.

All these locomotives have 20 by 26 in. cylinders and 12 in. piston valves which are set with a lead of 3/16 in. and are driven by Walschaerts motion. The driving-tires are 4 inches thick, and the driving wheel centers are fitted with bronze hub-plates. The driving-boxes are of cast steel. Solid forged and rolled steel wheels are used in the engine and tender trucks. The latter are of the arch-bar type, with cast steel bolsters.

It is interesting to note, in studying the dimensions of these engines, that 20 years ago, at the time of the Columbian Exposition, they would have been well above the average weight and capacity of locomotives engaged in heavy, through service on trunk line railroads.

The following are the general dimensions of these locomotives:

CONSOLIDATION TYPE.

Gauge, 4 ft. 8½ ins.; cylinders, 20 x 26 in.; valves, balanced piston.

Boiler.—Type, wagon-top; material, steel; diameter, 64 in.; thickness of sheets, ¾ in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Fire Box.—Material, steel; length, 107⅝ in.; width, 42 in.; depth, front, 70 in.; depth, back, 66 in.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water Space.—Front, 4 in.; sides, 3 in.; back, 3 in.

Tubes.—Material, steel; diameter, 5⅜ in. and 2 in.; thickness, 5⅜ in., No. 9 W. G.; 2 in., No. 12 W. G.; number, 5⅜ in., 22; 2 in., 165; length, 12 ft. 10½ in.

Heating Surface.—Fire box, 168 sq. ft.; tubes, 1,501 sq. ft.; total, 1,669 sq. ft.; grate area, 31.4 sq. ft.

Driving Wheels.—Diameter, outside, 52 in.; center, 44 in.; journals, 8½ x 9 in.

Engine Truck Wheels.—Diameter, 30 in.; journals, 5 x 8 in.

Wheel Base.—Driving, 14 ft. 2 in.; rigid, 14 ft. 2 in.; total engine, 21 ft. 10 in.; total engine and tender, 57 ft. 2½ in.

Weight.—On driving wheels, 140,600 lbs.; on truck, 15,800 lbs.; total engine, 156,400 lbs.; total engine and tender, about 275,000 lbs.

Tender.—Wheels, number, 8; diameter, 33 in.; journals, 5½ x 10 in.; tank capacity, 6,000 gals.; fuel, capacity, 12 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 319 sq. ft.

TEN-WHEELER TYPE.

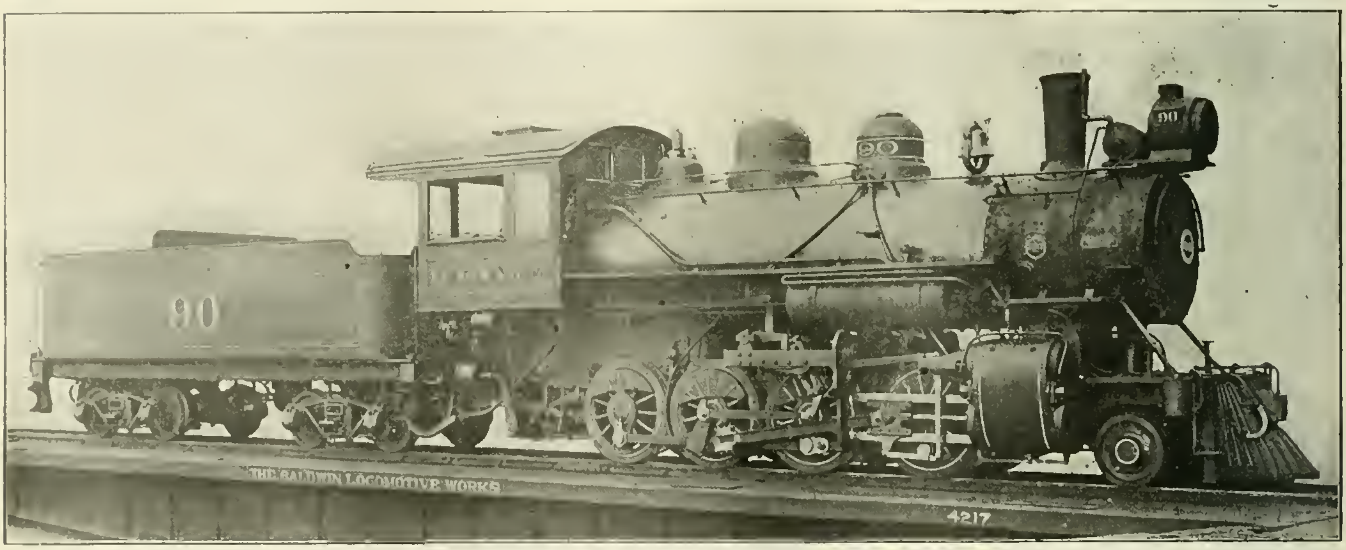
Gauge, 4 ft. 8½ in.; cylinders, 20 x 26 in.; valves, piston, 12 in. diameter.

Boiler.—Type, wagon-top; diameter, 64 in.; thickness of sheets, ⅝ in. and 11/16 in.; working pressure, 180 lbs.; fuel soft coal; staying, radial.

Fire Box.—Material, steel; length, 102 3/16 in.; width, 40¼ in.; depth, front, 71 in.; depth, back, 67 in.; thickness of sheets, sides, 5/16 in.; back, 5/16 in.; crown ⅜ in.; tube, ½ in.

Water Space.—Front, 4½ in.; sides, 3½ in.; back, 3½ in.

Tubes.—Material, steel; diameter, 5⅜



CONSOLIDATION 2-8-0 LOCOMOTIVE FOR THE LOUISIANA RAILWAY & NAVIGATION CO.

M. F. McCarra, Master Mechanic. Baldwin Locomotive Works, Builders.

in. and 2 in.; thickness, 5⅜ in., No. 9 W. G.; 2 in., No. 12 W. G.; number, 5⅜ in., 22; 2 in., 165; length, 13 ft. 11 in.

Heating Surface.—Fire box, 163 sq. ft.; tubes, 1,623 sq. ft.; total, 1,786 sq. ft.; grate area, 28.5 sq. ft.

Driving Wheels.—Diameter, outside, 60 in.; center, 52 in.; journals, main, 10 x 11 in.; others, 9 x 11 in.

Engine Truck Wheels.—Diameter, 28 in.; journals, 5½ x 10 in.

Wheel Base.—Driving, 14 ft. 0 in.; rigid, 14 ft. 0 in.; total engine, 24 ft. 9 in.; total engine and tender, 57 ft. 7½ in.

Weight.—On driving wheels, 118,550 lbs.; on truck, 40,000 lbs.; total engine, 158,550 lbs., total engine and tender, about 278,000 lbs.

Tender.—Wheels, number, 8; diameter, 33 in.; journals, 5½ x 10 in.; tank capacity, 6,000 gals.; fuel capacity, 12 tons; service, passenger and freight.

TEN-WHEEL TYPE LOCOMOTIVE FOR THE LOUISIANA RAILWAY & NAVIGATION CO.

Engine equipped with Schmidt superheater. Superheating surface 359 sq. ft.

Radium Springs.

Radium is of growing importance to mankind, and there is good reason for believing that it will cure diseases that have hitherto been considered beyond the aid of medical science.

About eighteen miles from Carlsbad is the small town of St. Joachimstal, where the Austrian government has one of its tobacco factories, and about three miles from that town, up in the hills, at a place which is difficult to reach are the imperial uranium works, which have become famous during the last few years on account of the radium found in the uranium stone. There is also a government factory at St. Joachimstal, where chemical colors are made from the uranium and shipped to all parts of the country. About four years ago the imperial managers of the uranium mines made a report to the government authorities that the water of the mine was found to contain radium, and medical experts have since declared that these waters are of high medical value in certain diseases.

Recently most of the Austrian newspapers have published items, according to which the Austrian government is convinced of the high value of these waters, and intends to take charge thereof, construct a proper radium spring, and build hotels, which it will control. The view of the government is that the beneficial effects of radium in a number of diseases have been admitted by the medical profession, but hitherto the application has been very expensive and treatment difficult. The government believes now that by the discovery of radium in those waters a powerful, and at the same time a cheap, medium has been found to make the power of radium accessible for bathing purposes.

Abortive Waterway Schemes.

Many things were brought out here during the Waterways Convention by the old-timers. They also recalled that the first big industry established at Pittsburgh was a shipyard, which continued in business until after the Civil War, during which period it built many of the single-turret monitors that lay in the mud at League Island for years and years.

Another fact brought to light by those who are delving into the history of waterway agitation is that De Witt Clinton and other promoters of the Erie Canal tried in vain to induce Congress to undertake the building of the canal on the plan of having the States accept gifts of land from the nation, in return for which the States—mind you, the States, not the nation—were to borrow money from the foreigners because they had better credit than the nation and could borrow at lower rates.

"And that Erie Canal gave New York the race for supremacy as an Atlantic seaboard port," said J. Hampton Moore to a knot of men who were discussing the plans for waterway improvement. "Before that time all efforts were directed toward getting into Philadelphia as the most desirable port."

A point not mentioned by Mr. Moore is that in 1809 Alexander Hamilton worked out a feasible scheme for a canal from Philadelphia to Pittsburgh that was to connect the Atlantic with the Mississippi River system, but Philadelphia was cold toward the scheme, while New York took hold of the Erie Canal scheme, put it through and reaped the benefit.

James B. Brady, Philanthropist.

Every railroad man knows the general supply man, James B. Brady, who has for years been a prominent figure at railroad conventions and was familiarly known as "Diamond Jim." The following is a copy of a despatch recently received from Baltimore by the New York *Tribune*:

"Contracts for constructing the James Buchanan Brady Urological Institute at Johns Hopkins Hospital have been signed by Mr. Brady in New York, and work will begin at once.

The main contract for the building that will house the urological clinic has been let to Henry Smith & Sons, of this city. Contracts for equipment and furnishings are ready also for Mr. Brady's signature. The total cost of the building, equipped and ready for occupancy, will be $235,000.

The clinic has been made possible through the philanthropy of Mr. Brady, better known as "Diamond Jim" Brady, who was a patient for eight weeks at the hospital in the spring of 1912.

Oil burning locomotives are to be introduced on the North Western Railway of India. Three coal burners and three oil burning locomotives will be on trial for six months to determine the relative values of coal and oil.

Electrical Department

Gas Electric Motor Car for the Midland Valley Railroad.

The number of gas-electric cars in operation in the United States is rapidly increasing. Railroad men are beginning to realize the economical operation that can be gained by the use of these cars on branch lines.

One of the most recent installations is the gas-electric car for the Midland Valley Railroad Company. This car will make one round trip a day over the northern division of the road, traversing 102 miles. The car is a combination passenger, smoking and baggage car. It measures 71 ft. 8 in. long over bumpers, 10 ft. 5 in. wide and weighs 52 tons, and has a total seating capacity for 86 people.

The apparatus is similar to that furnished by the General Electric Company in the other cars built by them, some of which we have described fully in a previous issue. The method of control is simple, substantial and similar to that of any electric trolley car. The gas-electric car, not only reduces the cost of operation for branch lines but it builds up these lines, since traveling is not only cleaner but more convenient. An installation of the gas-electric car may prevent the paralleling of the steam road by a trolley road and the retaining of local travel.

GAS ELECTRIC MOTOR CAR FOR THE MIDLAND VALLEY RAILROAD.

Automatic Controlling Device for Trains.

We are all acquainted with the Prentice wireless system of control for steam trains which has been in test service for several months over a section of track on the Canadian Pacific and on the London and Southwestern Railways.

Another system has been developed by Mr. A. R. Angus and experiments are being carried out on an experimental line at Watchet, England. Contact bars are placed at either end of each section or block and these bars, making contact with shoes mounted underneath the locomotive, establish an electrical circuit, operating relays which in turn control the throttle, air brake and whistle. The contact bars are set by the locomotive entering or leaving the block. A train following will have cab signals shown advising the engineer as to whether the block ahead is "clear" or "danger." Should the engineer for any cause fail to heed the warning if block is "danger," a set of contact bars will cause the closing of the throttle and the setting of the brakes automatically, at the same time operating the whistle.

The electric current for operating the cab signals and for operating the throttle, etc., is obtained from an axle-driven dynamo. A battery is provided to work in connection with dynamo in case the latter should fail.

Inclined Railway for Unloading Coal Operated by Electricity.

There are in operation along the shores of the Ohio River two inclined railways for unloading coal from the barges which bring the coal from the Eastern coal fields down the Ohio River. These railways are operated by electricity and have shown themselves to be very economical and moreover require far less attention than was necessary with the old fashioned types driven by steam. One of these located at Cincinnati, Ohio, is owned by the Whetstone Coal Company and has a total capacity of 800 tons.

The cars are pulled up an incline by a steel cable wound on a drum which is driven by an electric motor. An ingenious method is used for automatically unhooking the cars from the cable when they reach the top the car continuing along the level track to the proper bin where the load is dumped. Under ordinary conditions 150 to 200 cars are hoisted per day at a cost of about .019 cents per ton of coal.

Electricity in Arabia.

The Sultan of Oman at Muskat, Arabia, had installed recently at his palace an electrical plant to be used for lighting and other purposes. This is reported to be the first electrical installation in that country.

Coating of Lead on Iron and Steel.

Electricity has been used for several years in electroplating of silver, copper, etc. A process has just been devised for the coating of iron and steel with lead electrolytically. A coating up to the thickness of ⅛ inch can be economically deposited and it is stated that the method is suitable for the protection of iron and steel from corrosion.

The electrical department of the H. W. Johns-Manville Company, New York, announces that it has recently completed the installation of lighting fixtures to the value of $19,500 in the New York Central Railroad Company's new station at Rochester, N. Y.

Portable Substations.

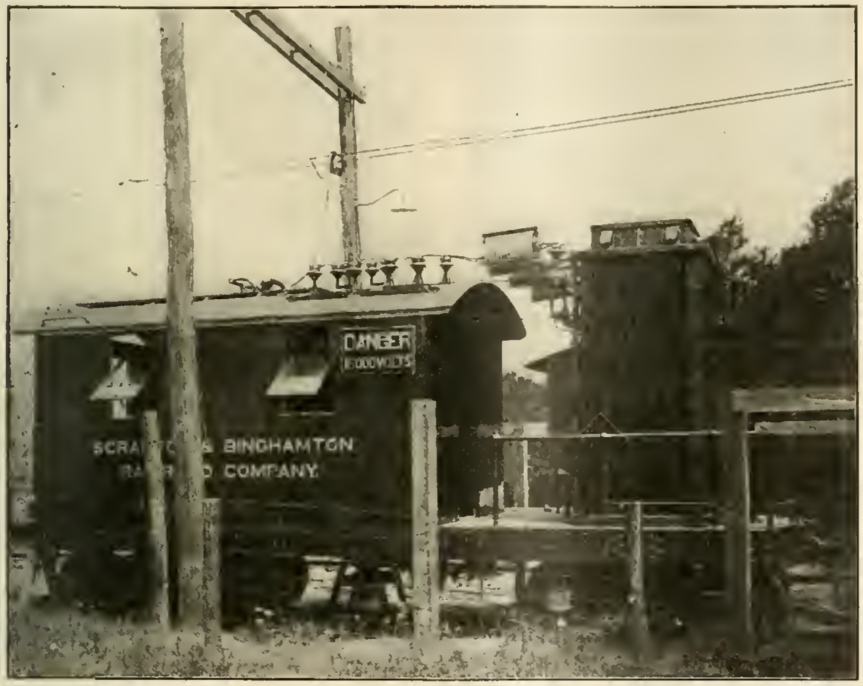
Many electric railroads are confronted at certain times of the year and at certain places by a shortage of power. When extra cars are placed on the line to handle rush conditions, especially when they are bunched at one place, the large amounts of electric current put a severe tax on the substations and very poor power is the result. The voltage is greatly reduced due to the fact that the large amounts of current required can not pass over the wires from the substation without heavy losses.

The portable substation is the solution. If large crowds are to be handled from a "country fair" or other assembly the portable substation can be located on a spur at this place and the load handled without trouble or delay.

They are known as the air-break Burke type switch. When the switch is closed the horns are shunted by a blade. In opening, the horns stay in contact until after the blade is open, then they swing open and the arc is taken on the horns and extinguished thereon. These switches will operate satisfactorily on voltages up to 60,000.

This complete outfit is manufactured by the Westinghouse Electric & Manufacturing Company. There are many of these substations in operation. An order was recently received from the Greenville, Spartanburg & Anderson Railway Company.

The advantages are many: It constitutes a spare equipment; it can be used to increase the capacity of a permanent substation; it can be used to determine the most advantageous point at which to locate a permanent substation; and it can be used to provide service while a permanent substation is being overhauled or rebuilt.



PORTABLE SUBSTATION ON THE SCRANTON & BINGHAMTON R. R.

A substation of this kind is especially of value to interurban and cross country electric railroads. As is generally known, the power for most of these railroads is generated at one or more power houses located, perhaps, several miles away and transmitted over wires at high voltage to the various substations where it is changed to direct current at 500 to 600 volts.

The illustration shows one of these portable substations in use on the Scranton and Binghamton R. R., temporarily connected to the high voltage wires overhead. All of the parts carrying electric current known in the electrical field as "live" parts, are protected to minimize the danger of accidental contact.

The high voltage switching and protective apparatus is mounted out of the way in the roof, but is operated from the cab. The horns shown in the photograph make and break the high voltage current.

Electrification on the Pennsylvania.

The Pennsylvania Railroad Company announced recently that the board of directors had authorized the electrification of suburban service on the New York division to Chestnut Hill, a distance of 12 miles from Broad Street station Philadelphia. The work, which will be completed by the fall of 1914, will involve an expenditure, including multiple-unit equipment, of $1,250,000. It has been determined that the electrification of the Chestnut Hill branch in connection with the electrification of the main line to Paoli offers the most prompt and effective plan, pending the further development of the company's final terminal plans, for congestion relief, since it is essential to obtain as quickly as possible greater train capacity in the present station at Broad Street. There are now eighty-five trains each day in and out of Broad Street station and sixty-six trains to and from the Chestnut Hill branch, all of which will be operated by electricity. It is very probable that the energy for the system will be purchased from the Philadelphia Electric Company, negotiations to that effect being still under way.

Electrification of Montreal Tunnel and Terminal.

The terminal of the Canadian Northern Railway is to be electrified, using 2,400 volts direct current. An order has been placed with the General Electric Company for seven electric locomotives and eight multiple unit cars. The terminal electrification will consist of 10 miles of double track between the passenger and freight terminals in Montreal and the Cartierville yards beyond the town of Mount Royal where the trains will change from steam to electric and vice versa.

The locomotives will have all weight, 80 tons, on drivers and will be equipped with four motors geared to the drivers through twin gears.

Electrification Held Up in Chicago.

The ordinance submitted to the Chicago City Council last spring, which contained provisions for the electrification of the railroad terminals and the abatement of the smoke nuisance, was again referred to committee for further investigation and recommendations. This action was taken owing to a protest raised by five organizations representing more than 55,000 members, all of whom are railroad employees in and around Chicago. They charge that the ordinance is unfair to them as compliance with its provisions would endanger the lives of railroad employees and cause many of them to lose employment because of the change from steam to electricity.

American Electric Railway Association.

The thirty-second annual convention of the American Electric Railway Association and its allied and affiliated bodies, the American Electric Railway Accountants' Association, the American Electric Railway Engineering Association, the American Electric Railway Claims Association and the American Electric Railway Transportation and Traffic Association was held in Atlantic City, N. J., on October 13, 14, 15, 16 and 17.

A number of reports and individual papers were presented before each meeting of the associations. Mr. Charles N. Black, vice-president and general manager of the United Railroads of San Francisco was elected to the presidency for the ensuing year.

Items of Personal Interest

Mr. W. H. Sasser has been appointed general foreman of the Southern, with office at Rome, Ga.

Mr. Mark Jefferson has been appointed assistant master mechanic of the Lehigh Valley at Easton, Pa.

Mr. J. E. Hutchinson has been appointed master mechanic of the Payette Valley, Payette, Idaho.

Mr. George Tier has been appointed general foreman of the Santa Fe, with office at Emporia, Kan.

Mr. J. J. Robinson has been appointed general foreman of the Southern, with office at Greenville, S. C.

Mr. W. E. Johnston has been appointed car foreman of the Great Northern, with office at Skyomish, Wash.

Mr. A. Copony has been appointed master car builder of the Grand Trunk, with office at Port Huron, Mich.

Mr. H. Below has been appointed shop foreman of the Manistee & Northeastern, with office at Manistee, Mich.

Mr. R. H. Erehart has been appointed master mechanic of the Missouri Southern, with office at Leeper, Mo.

Mr. J. P. Welsh has been appointed roundhouse foreman of the Minneapolis & St. Louis at Marshalltown, Ia.

Mr. R. Quayle has been appointed master mechanic of the Otsego & Herkimer, with office at Hartwick, N. Y.

Mr. J. O. Snively has been appointed master mechanic of the Monroe & Southwestern, with office at Monroe, La.

Mr. J. L. Hodgson has been appointed master car builder of the Grand Trunk Pacific, with office at Winnipeg, Man.

Mr. J. B. Quackenbush has been appointed road foreman of engines of the Erie, with office at Jersey City, N. J.

Mr. Edward Boas has been appointed master mechanic of the Cincinnati, Hamilton & Dayton, with office at Indianapolis, Ind.

Mr. James Howard has been appointed master mechanic of the East Jordan & Southern, with office at East Jordan, Mich.

Mr. E. R. Larson, has been appointed supervisor of apprentices of the Delaware, Lackawanna & Western at Scranton, Pa.

Mr. E. A. Corey has been appointed foreman of locomotive repairs of the Chicago & Alton, with office at Roodhouse, Ill.

Mr. James Reed has been appointed assistant master car builder of the Chicago, Indiana & Southern, with office at Englewood, Ill.

Mr. H. R. Warnock has been appointed superintendent of Motive Power of the Western Maryland, with office at Hagerstown, Md.

Mr. C. A. Kurrasch has been appointed master mechanic of the Superior & Southeastern, with office at Grand View, Wis.

Mr. J. C. Brown, has been appointed road foreman of engines of the St. Louis Southwestern of Texas, with office at Tyler, Tex.

Mr. J. J. McGuire has been appointed master mechanic of the Baltimore & Ohio, with office at Newcastle (P. O., Mahoningtown), Pa.

Mr. C. E. Lowe has been appointed road foreman of locomotives of the Chicago, Burlington & Quincy, with office at Brookfield, Mo.

Mr. G. F. Silvia has been appointed general mechanical and electrical superintendent of the Albany Southern, with office at Albany, N. Y.

Mr. W. J. Hohr has been appointed general foreman of the locomotive department of the Baltimore & Ohio, with office at Benwood, W. Va.

Mr. D. W. Williams has been appointed assistant division master mechanic of the Philadelphia & Reading, with offices at Philadelphia, Pa.

J. D. Kilpatrick, formerly district mechanical superintendent of the Chicago, Rock Island & Pacific, has been elected vice-president of the Chicago Air Brake Co., 327 So. LaSalle street, Chicago.

Mr. D. M. McLauchlan has been appointed master mechanic of the Corvallis & Eastern, with office at Albany, N. Y., and Mr. R. C. Harden has been appointed dispatcher of the same road, also at Albany.

Mr. R. Wilson has been appointed division master mechanic of the Chicago Great Western, with office at Oelwein, Ia., and Mr. H. Brinkman has been appointed locomotive foreman of the same road, also at Oelwein.

Mr. W. J. Davis has been appointed general foreman of the Detroit, Toledo & Ironton, with office at Lima, Ohio, and Mr. O. S. Throop has been appointed to a similar position on the same road, with office at Delray, Mich.

Mr. C. A. McCarthy, formerly master mechanic of the Chicago, Rock Island & Pacific at Shawnee, Okla., has been appointed master mechanic of the Colorado Springs & Cripple Creek, with office at Colorado Springs, Col.

Mr. W. Rothmeyer, Road Foreman of Engines of the Missouri, Kansas & Texas has been assigned the duties of Master Mechanic at Sedalia, Mo., the latter title having been abolished with the resignation of Mr. G. P. Letts.

Mr. W. Griffith has been appointed master mechanic of the Pere Marquette, with offices at Saginaw, Mich, and Mr. Thomas Kelley and Mr. P. K. Pierce have been appointed road foremen of engines on the same road, also at Saginaw.

Mr. G. N. Howson, master mechanic of the Southern Ry., at Princeton, Ind., has been appointed superintendent of the Western district, with headquarters at Louisville, Ky., succeeding Mr. F. W. Brown, who has retired from railroad service.

Mr. W. J. Fraudendiener, formerly superintendent of shops of the Lake Shore at Elkhart, Ind., has been appointed General Inspector of the locomotive department of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Indianapolis, Ind.

Mr. Joseph Maltby has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha, with office at Omaha, Neb., and Mr. C. A. Schubert has been appointed to a similar position on the same road, with office at Altoona, Wis.

Mr. W. C. Garaghty, formerly supervisor of machinery of the Cincinnati, Hamilton & Dayton, has been appointed road foreman of engines of the Baltimore & Ohio Southwestern, and Cincinnati, Hamilton & Dayton Railway terminals at Cincinnati, O.

Mr. R. W. Schulze has been made Superintendent of the Car Department of the St. Louis & San Francisco, with headquarters at Springfield, Mo. He recently resigned as General Car Foreman of the Gulf, Colorado & Santa Fe, at Cleburne, Tex.

Mr. J. E. O'Brien, formerly superintendent of motive power of the Western Pacific, at Jeffery shops, Cal., has been appointed assistant mechanical superintendent of the Missouri Pacific & St. Louis Iron Mountain & Southern, with offices at St. Louis, Mo.

Mr. G. H. Funk, superintendent of fuel economy of the Chesapeake & Ohio, has been appointed general smoke inspector of the Cincinnati territory by the railway companies. Mr. Funk will work in conjunction with Mr. A. G. Hall, smoke inspector of the city of Cincinnati, O.

Mr. J. B. Roach, formerly master mechanic of the Chicago, Burlington & Quin-

cy, at Aurora, Ill., has been transferred to Beardstown, Ill., to a similar position on the same road. He succeeds Mr. H. G. Cartron, who has been transferred to Brookfield, Mo., as master mechanic.

Mr. G. Fred Collins, who for many years has been well and favorably known in the railroad supply business, has become associated with the Protectus Paint Company, in their selling department. His address is North American Building, Philadelphia. Mr. Collins' success has been so marked that it is already rumored that he will later take charge of a new branch office that will be opened in Pittsburgh in the near future.

Mr. A. E. Tanner, has ben appointed general foreman of the Chesapeake & Ohio, with office at Logan, W. Va. Mr. R. E. Bransford has been appointed foreman of the mechanical department of the same road, at Hinton, W. Va. Mr. T. W. De Way, has been appointed to a similar position on the same road at Covington, Ky., and Mr. J. A. Barker has been appointed road foreman of engines on the same road, with office at Peru, Ind.

Mr. J. Allen Smith, president of the United States Light & Heating Company, has just started on his second trans-Atlantic trip of the year. Mr. Smith has already been eminently successful in bringing the company's fine products prominently before the leading railroad and other companies in British and European countries, and Mr. Smith purposes visiting the various machinery exhibitions which are held earlier in Europe than in this country.

Mr. H. C. Dimmitt has been appointed assistant district master mechanic of the Chicago, Milwaukee & St. Paul at Minneapolis, Minn., and among other promotions on the same road are the following, appointed to the position of road foreman of engines: Mr. John Turnly, at Minneapolis, Minn.; Mr. James Chaloupka, at Dubuque, Ia.; Mr. W. H. Hart, at Milwaukee, Wis.; Mr. G. P. Hodges, at Minneapolis, Minn.; Mr. P. H. Kiley, at Savannah, Ill., and Mr. A. J. Klumb, at Milwaukee, Wis.

Mr. A. D. Wyckoff has been appointed eastern railroad representative of S. F. Bowser & Co., Ft. Wayne, Ind., to take the place of Mr. Frank T. Hyndman, who has recently been appointed Superintendent of Motive Power and Cars of the Wheeling and Lake Erie Railroad. Mr. Wyckoff has been in the service of S. F. Bowser & Company for a number of years as efficiency expert and has had a very wide experience in designing equipment for the handling and storage of oils, as well as oil filtering and circulating systems for railroad and manufacturing institutions. Mr. Wyckoff is ready to answer any questions pertaining to oil storage and distribution and will gladly co-operate with anyone in working out the best possible system for their needs.

Mr. L. A. North, who was recently appointed shop superintendent of the Illinois Central Burnside shops, at Chicago, Ill., and who was formerly general foreman in the shops, has been prominently identified with the International Railway General Foremen's Association, and was vice-president in 1912, and was re-elected

L. A. NORTH.

at the last annual convention held in Chicago in July last. He is a fine type of the Western railroad man, and his appointment as superintendent of the principal shops of the Illinois Central is meeting with the approval of all with whom he comes in contact.

Mr. C. C. Bradford, formerly manager

C. C. BRADFORD.

of the Cleveland branch office of the United States Light & Heating Company, has been appointed sales manager at the company's New York office, 30 Church street. Mr. Bradford's success in establishing the Cleveland branch has been particularly marked, and the rapid growth of the company is such that it bids fair to become the leading factor in the manufacture of specialized electrical apparatus, particularly storage batteries, electric starters and electric train lighting devices. Mr. R. B. Clark, with the title of acting manager, succeeds Mr. Bradford at the Cleveland office.

Mr. W. U. Appleton, formerly assistant to superintendent of motive power of the Intercolonial, at Moncton, N. B., has been appointed general master mechanic of the Intercolonial and the Prince Edward Island railways, in charge of all engine houses and shops, excepting the shops at Moncton, and all locomotives and machinery, and Mr. Joseph Graham, formerly erecting house foreman at Moncton, has been appointed superintendent of the locomotive shops at Moncton. Among other changes on the Intercolonial, Mr. H. W. Sharpe, formerly acting master mechanic at Riviere du Loup, Que., has been appointed district master mechanic at that point. Mr. T. W. Hennessey has been appointed district master mechanic at Campbelltown, N. B. Mr. W. E. Barnes has been appointed district master mechanic, with office at Moncton, and Mr. H. D. Mackenzie, formerly general locomotive foreman at Moncton, has been appointed district master mechanic with office at Stellarton, N. S.

Obituary.

John F. Ensign.

Mr. John F. Ensign, chief inspector, Division of Locomotive Boiler Inspection, Interstate Commerce Commission, died at his home in Washington, D. C., last month, at the age of 51. Mr. Ensign was the first man to hold the office of Chief Inspector of the Federal Locomotive Boiler Inspection Service.

Dr. Rudolf Diesel.

Dr. Rudolph Diesel, who is reported to be drowned at sea on September 30, was born of German parents in Paris, in 1858, and was educated in England. He was engrossed for many years with the idea of discovering a prime-mover having a much higher thermal efficiency than the steam engine, and in 1893 he published a book on the subject which attracted wide attention in Germany, and a great variety of engines bearing his name have been manufactured and all of the internal combustion kind, and during the present year the first Diesel-engined locomotive has been built. The merits of his invention, if it may be called an invention have created much discussion. Some eminent engineers assert that the claims made on behalf of the Diesel oil engine were ridiculous, and were inspired by those financially interested in oil combinations. All engineers regret, however, that such an active life should be cut off just as some measure of success seemed assured.

Training Railway Apprentices.

The writer, who has supervising charge of the Erie Apprentice Schools, has been very much struck with the methods of instruction pursued by Mr. H. E. Blackburn, inspector of apprentices at the Erie shops, Dunmore, and intended writing a description of the practices adopted, but an admirable description has been contributed by Mr. Blackburn to the Erie Railroad Employee's Magazine, which is here reproduced:

According to the *Manual Art Press,* of Peoria, Ill., a paper devoted to vocational education, the first trade school was started in 1829 by Baron de Hirsch.

Peter Cooper is credited with starting the famous Cooper Union School in New York City, in 1859, and no doubt this was the first free-trade night school in the United States.

John Purcell, of Argentine, Kan., formed a class of thirty-two shop employees in 1899 at the Santa Fe Railroad shops. Twelve of these boys later on became shop foremen, and at the present time eight of these foremen are master mechanics. You often hear these men tell about the "Old Purcell School."

The Grand Trunk Railroad started the first Railroad Apprentice School at Battle Creek, Mich., in 1902. The Santa Fe Railroad started to educate all the apprentice boys on its system in 1905.

Other railroads, seeing the success that the Grand Trunk and Santa Fe lines were having with their apprentice schools, soon fell in line, and at the Master Mechanics' Convention at Atlantic City in 1909, the matter of education for the apprentice boys was freely discussed, and steps were taken to endorse a policy to meet the demand for skilled mechanics.

At the General Foremen's Convention, which met in Chicago this year, the committee appointed to take up the apprentice question, reported as follows:

Twenty-five railroads had apprentice schools, embracing 168 shops, employing 61 teachers, in instructing 4,925 boys.

"Seventy per cent. of the boys who started in to learn the trade finished, and 77 per cent. of the boys who finished their time stayed with the railroads as journeymen."

The committee also stated that the teacher, as a social engineer, was responsible for placing boys in the shop, who were good material and agreeable help to all concerned, and that boys so obtained were of a much better class than those that were taken on as they came along.

The rapid development of the trades, and the introduction of piecework, soon made specialists of the mechanics, and in their rush to get output and, consequently, size up the almighty dollar, the boys whom they formerly coached, were soon forgotten. The boys then looked to the foreman for help, but the foreman, also, had new duties placed upon him too numerous to mention, and, as a last resort, the boys just stood by and looked on, as it were, without knowing the reason why such a job was done so and so.

To overcome this new condition, the railway officials began to place practical mechanics in their shops to teach the boys the what, how and why of the trades.

Judge Lindsay, of Denver, who is an authority on boys, says: "You take a long chance on recommending a boy as good material for some one branch of the trade, when the boy is only sixteen years old, and the public school system should have some form of trade work in it, so as to sift these boys out by the time they may be compelled to work for a living; then a sixth-grade boy would be able to start on his trade, if his inclinations ran that way, at the age of sixteen."

If this boy uses his public school education, along with his railroad apprentice school shop course, he should be able to guide his hands so as to finish his trade in three years.

If he then enters the shop as a journeyman, and studies his work intelligently, he should qualify for a foremanship in six years' time. If he is not that ambitious, he is sure of a good living at the price they are paying for skilled mechanics at the present time, and if he is not a skilled mechanic, he is "strictly in wrong," for, with all the apparatus and teachers to show him, there is no excuse for the half-baked mechanic, for unskilled labor is now only employed where muscle and brawn counts.

It is an old and true saying, "What you want in the minds of the men, first put in the minds of the boys," and when a teacher undertakes to handle fifty boys, two-thirds of them, perhaps, full of the "devil" (and if they are not built that way they, as a rule, seldom make good), he is up against a serious proposition.

To obtain the good will of a few offenders, who will do tricks seemingly mean, but, really, without malice, is to study each boy separately.

The only way to handle boys, as a class, has not been discovered as yet. Scientific management has not helped this problem any, as yet. The only way to handle a boy thoroughly is to put yourself in the boy's place, and remember how it fared with you when you were "going some" in the shop in your early days. You must be as fierce with the boy as you can, without hurting his feelings, for if you hurt his feelings, or any other part of his makeup, you are liable to make him a hero in the eyes of "his gang." A good rule with the boy is, that he will never take to you until you can overlook some of his tricks.

Of course, natural inborn cussedness will crop out of the average boy now and then. It did with you, and it always will with boys who amount to much later on. Check up on the model young men of your youth, and see how many of them ever fought their way to the top. You will always find the worst "devils" looming up later on.

Laying boys off doesn't help matters any; in fact, some boys obtain their Summer vacation that way. Mother wit and good common sense is a good combination to lick boys with.

If a boy spoils a piece of work, after you have taken considerable pains to show him about how it should have been done, don't "fire up;" find him another piece of material, and keep him interested, as long as he does not become "sassy." If he is so inclined, place him on some other work—something that he does not like, such as snagging castings, and tell him why he is there, until you get his "goat."

On the other hand, if a boy does a piece of work well, compliment him on it, and move him on to a better class of work, and tell the boy who is asleep at the switch, why he has been sidetracked from the good grade of work. Perhaps there is a circus day you could rob him of to further help him to pull out on the main line again, and when he gets busy again, give him an important job to make up for lost time.

There always are boys whom you can tell a thing several times before they will see the point. There is a vast difference between this grade of boys and the class you have to tell three times before they want to see the point. Then there are a few boys you only have to tell the first time, and they understand what you want. It is wise to pick out one of these boys for an assistant teacher, in case you wish to lay off some day to see what the other teachers are doing.

Occasionally you run up against a boy (let us hope only one), who knows it all, without being informed. This boy is a hard proposition to handle. Let him figure out something you can't do yourself. It will please the boy, and perhaps enlighten the teacher; anyway, his mind will be busy.

Coaxing boys to be good, is a poor form of discipline. Awarding prizes is expensive, and the boy works for the prize only. Intimidating him is also a very poor practice. It is much better form to find out what his pet hobby is, and to interest him along those lines, until you can arouse his curiosity, by direct application to models and the up-to-date problems of the day. Talk baseball or football in season, but don't fail to show him how the balls are made. You should know these little things, and you will if you read the many trade journals of the present day. You will never graduate from the school of experience, and the boy is not much interested in what you

did yesterday. He wants something new for tomorrow if you are to keep him on the list of improvements in your school.

An effectual means of interesting the boys is to pass out various trade journals and catalogues of modern tools and machinery, and it is certainly a cheap, up-to-date form of circulating library. It helps the boys in forming a taste for technical books, and trade journals; also the printer. Later on it fosters the spirit of self help, and a desire to know more. To say the least, it is much better than to force some out-of-date text book upon the boy, at a price he is unable to stand.

Trade training, with intellectual development, is the only way to form a clear understanding of the reason for doing the work as it should be done.

Manual dexterity is purely mechanical and a boy soon becomes tired, unless industrial intelligence is mixed with his work. Mental laziness is the correct term for boys who like to work without thinking. Their motto is, "The more I work, the more I receive."

It is much better to explain what kind of a horse James Watt used when it lifted 33,000 lbs. Tradition has it that a heavy brewery horse (whatever that is) was used, and that the weight was raised from the bottow of a well. By pulling horizontally on a rope passing over a pulley, it was found that a horse could raise a weight of 100 pounds while walking at the rate of 25 miles per hour, or 220 feet per minute. This is equivalent to 22,000 foot pounds per minute. Watt, like all engine builders, added 50 per cent. more so as to make sure, thus 33,000 pounds leaves the sporting class of boy in doubt, unless it is explained correctly and not like the formulae below:

$$o = \frac{f \times v}{33{,}000} \qquad f = \text{Tractive effort}$$

$$\frac{f \times v \times 5{,}280}{33{,}000 \times 60} \qquad v = \text{Speed in miles per hour}$$

$$o = \text{Horse power}$$

$$\text{or}: o = \frac{f \times v}{375} \text{ Horse power}$$

It is well to show the boy that a foot pound is the force required to raise a weight of 1 pound a distance of 1 foot in 1 minute before you talk about 30 horse power engines. It is also well to show the boy that 90 degrees of heat on a thermometer does not mean the amount of heat or pressure in the air, but the degree of heat only, for 1 degree is the actual quantity of heat required to raise 1 gram of water 1 centigrade in temperature.

Then show the boy where the much-talked-about and seldom understood B t. u., or British thermal unit, comes into use.

If water freezes at 32 degrees and boils at 212 degrees, it will take the difference, or 180 degrees of heat, or 1.80 B. t. u., to melt 1 pound of ice and to boil the water.

Arithmetic, as taught in the public school, defines a right angle triangle as follows: In a right angle triangle, the square of the hypothenuse (whatever that is), equals the square root of the base, plus the square of the vertical height, or calling the vertical height "A," the base "B" and the hypothenuse "C," we say:

$c^2 = a^2 + b^2$ OR $c = \sqrt{\ } a^2 + b^2$.

But, as we know "C" to be 2 inches and the base "B," 1 inch, we must find "A." Transposing the formula we have:

$a^2 = c^2 - b^2$ OR $a = \sqrt{\ } c^2 - b^2$ AND $b^2 - a^2$ OR $b = \sqrt{\ } c.^2 - a^2$.

THEN $a = \sqrt{\ } 4 - 1 = 1.733$ INCHES

THIS $\times 1 = 1.733$ SQ. INCHES.

Now, in shop practice, to save paper, time and pencils, to say nothing about your health, they cut out this "hot air" and multiply the height by the base and divide by 2. If you want a boy to hate you, use school arithmetic, but if you are after a life-long friend, show the boy the shop edition.

Don't let a boy use up a pad of the company's paper in finding that the areas of 350 tiles, 12 inches square, are the same as 700 tiles, 8 x 9 inches. Show him that he can work it out in his head, about two 8 x 9 tiles having the same area as one 12 x 12 in.

Ninety per cent. of the problems on electricity can be worked out by the ordinary mechanic, so that he can get a fair knowledge of the coming power, and if you don't wake up to this fact, they will be running electric engines by your house, without your knowing what the trolley wire is made of.

Volts, amperes, watts and kilowatts are as foreign to most machinists as hydrostatic pressure, steam horse power, brakes and superheaters are to the electrician.

The volt is a unit of electro-motive force, the same as the pound pressure on a pressure gage; thus 200 volts current is like 200 pounds pressure of water flowing through a pipe.

The ampere is the unit of measuring the quantity of electro-motive force, or electricity used, or, what is flowing through the wire, the same as the pounds or gallons of water flowing through a pipe. Thus, 200 amperes of 600 volts current has twice as much power as one using 100 amperes at 600 volts. The force or pressure remains the same, while the amperes or quantity varies.

The watt is the unit of electric power, or force, the same as the horse power on a steam engine. Thus, 600 volts and 250 amperes $= 60 \times 250$, or 15,000 watts. It takes 746 watts make one horse power on a steam engine.

A kilowatt is a convenient reduction to measure by, like calling 12 inches 1 foot, or 150,000 watts = 150 kilowatts, or 1 1-3 horse power.

If you pay 80 cents for 1,000 cubic feet of gas per hour, you are getting it cheap, compared to the fellow who is paying 80 cents for a kilowatt hour's worth of electricity, which, by the way, is some price for the "juice."

The system of wiring is best compared to a pipe line filled with water and having a circulating pump coupled in, in place of a dynamo. The water pressure is the same as the voltage, and the gallons or pounds of water flowing through the pipes at the pressure is the amperes. The horse power of the pump would compare with the kilowatt of the electric motor.

Series parallel, or full parallel, is compared to the plain, simple, compound, or mallet steam locomotive.

Most electric engines of today have four motors, the current passing through these four motors, one after the other, or what is known as the "series group class."

When the circuits are arranged so as to pass through two groups of motors, each group having two motors, they are called series parallel, or series multiple.

If four motors receive the current direct, without going through the other motors, they are classed as "full parallel."

If seemingly hard problems were explained to the boys in a plain, everyday course talk, and less of the text book formulaes used, there would be less of a class of boys who are conspicuous for what they do not know.

Of course, if the teacher cannot tell a boy who regards his work as a "job," from a boy who looks on his job as his work, in order to do things so as to make a living, it is time to let some one else do the selecting of the boys, but even then you will find boys who look good at the start, who are noted later on—more for what they do than what they know. It is not their ability to turn out work, but their ability to get clear of doing any work at all. The only solution is to "get a new boy."

As a rule, sons of employees make the best mechanics, especially if they have good school training before they enter the shop. Physical fitness and mental ability are also vital requirements.

The co-operation of the master mechanic is absolutely necessary; also the shop foremen, to a man, if the school is to prosper.

100 per cent. means an excellent record
90 per cent means a fair record.
75 per cent. means a failure record.

And any mark less is a "down and out" case for the boy.

The rules best adapted for the above percentage are taken from the following examinations:

Is he prompt?

Is he careful?
Is he fit for the work in hand?
Does he stay with a job until done?
Does he work well without help?
Does he work for results?
Does he do what you tell him to do?
Has he energy to do things?
Has he ability to meet conditions?
Has he any serious faults?
Has he any bad habits?

There is but little doubt that the workshop is the only place to educate the boy. The industrial school merely supplies a thin scale education, which can never compete with the practical education in the shop.

Labor organizations are sometimes aggressive toward too many apprentices being employed, but investigation shows there are 48 trades, representing 500,000 men, who have no restrictions as to how many boys shall be employed per one mechanic.

In considering the public interest in vocational education, it will be assumed that all agree on the necessity, but differ as to the best methods to use. It should be free to start with, and compulsory to finish with, as far as the theoretical side of the training is concerned.

Andrew S. Draper puts it as follows: "It is at all times to be kept sharply in mind that the schools are not only to educate people in order that they may be educated.

"But, also, to educate them, in order that they may do things."

Mud Ring and Flue Sheet Drill.

The four spindle machine shown herewith was brought out by the Foote-Burt Company, of Cleveland, Ohio. This machine is for use in railroad locomotive boiler shops and general boiler shops for drilling the rivet holes around a mud ring and for cutting out the flue holes in a flue sheet.

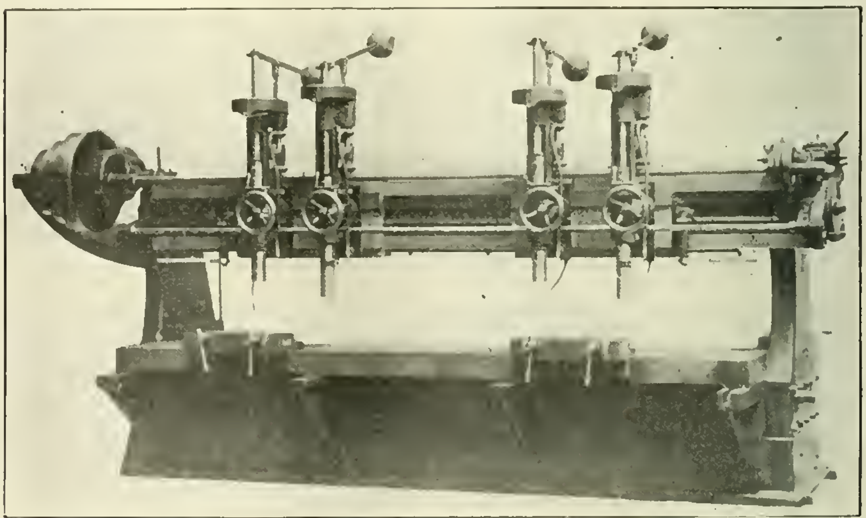
The spindles are the independent feed type, each one being arranged with automatic knockoff to power feed, and the quick return of same is taken care of by the use of hand wheel located on the front of the head. Each spindle is also arranged with clutch for stopping and starting and interlocking mechanism so that the feed cannot be thrown in with the spindle stopped or vice versa. With this independent feed feature some of the spindles are always drilling, while the operator is setting the other spindles, so that the full efficiency of both the machine and the operator is obtainable, as no time is lost as on the gang feed type.

The spindles of this machine are arranged in pairs which are mounted on auxiliary crossrails and the spindles are adjustable on these crossrails to a minimum center distance of eight inches. The advantage of this feature is that it is possible to set the spindles to the proper spacing of the rivet or flue holes and then adjust two spindles along the main rail of the machine, maintaining the proper spacing and eliminating the necessity of spacing each one individually.

The spindles overhang the front edge of the base eight inches to take care of the mud ring work and the table is provided with chucks for holding the mud rings. The table has an in and out motion of thirty-six inches and is supported out under the spindles by the bracket slides on the front of the base.

Three changes of power feed are provided, any one of which is instantly available by simply shifting a lever at the right hand end of the machine. Six changes of speed are provided by three step cone and throwout back gears.

The machine weighs approximately 21,000 pounds.



FOOTE-BURT COMPANY MUD RING AND FLUE SHEET DRILL.

Chemical Feeder.

A patent has been granted to Joseph H. Cooper of Paola, Kan., and assigned to the Dearborn Drug & Chemical Works of Chicago, for a chemical feeder which seems to be particularly useful for locomotives that require to have the feed water treated for hardening impurities.

The invention calls for the installation of a reservoir to hold the chemicals which are supplied to the boiler by the injection. The connections are so arranged that the injector operates automatically to control the supply of compound or chemical in proportions predetermined in accordance with an analysis of the water fed to the boiler. The chemical supply pipes are connected with the suction pipes or chambers of the two injectors. Each of the chemical supply pipes is provided with a check valve, whereby the operation of either injector will effect the proper operation of the chemical feeding apparatus without interference from the other injector and the connections thereto. The chemical supply pipes are provided with shut-off valves and sight feeders. The pipes leading to the two injectors are combined and led through a single tube to a point near the top of the chemical supply tank. The result is that a suction upon the chemical feed pipe system is necessary to raise the chemical solution from the storage tank. When, therefore, the injectors are not in operation, the supply of chemical automatically ceases. When, however, either injector is put in operation, the suction created in the chemical supply pipe raises the chemical solution from the bottom of the storage tank to supply chemical in proper proportion, as determined by the setting of the chemical regulating valve.

This valve is of novel construction and function, and is arranged to prevent incrustation and faulty and irregular operation resulting therefrom. The regulating valve is at the bottom of the induction tube of the chemical supply tank, whereby it is kept always in the chemical solution. This alone would go far in preventing incrustation of the valve, but in addition to this, the valve is mounted at the end of a very long, slender stem, preferably of steel. The inevitable vibration of the rod, at the end of which the valve is mounted, causes a movement of the valve which also will prevent an accumulation of sediment.

This seems to be a thoroughly practical invention, devised by one who understands the operation he tries to accomplish.

Razor Strops from Old Belting.

"Old belting which has been in use for a couple of years and subjected to an enormous pulling power during that time is found to fulfill every requirement of the ideal leather, if it is not too oily. The oil can be removed, however, by using pumice stone. Many razor manufactories get their leather by buying up old belting."

RAILROAD NOTES.

The Great Northern has ordered 20,000 tons of rails from the Illinois Steel Co.

The Pere Marquette is said to be in the market for about 10,000 tons of rails.

The Pennsylvania lines west, it is reported, will purchase a number of locomotives.

The Buffalo, Rochester & Pittsburgh is said to be in the market for ten locomotives.

The Missouri Pacific has ordered 10,000 tons of steel rails from the Pennsylvania Steel Company.

The Belt Railway, of Chicago, has ordered ten switchers from the Lima Locomotive Corporation.

The Chicago, Burlington & Quincy has ordered 25,000 tons of rails from the Illinois Steel Company.

The Lehigh Valley, it is reported, has ordered 3,000 tons of rails from the Carnegie Steel Company.

The Chicago & North Western has ordered twenty Mikados from the American Locomotive Company.

The Pennsylvania Lines West are said to have ordered fifty locomotives from the Baldwin Locomotive Works.

The Philadelphia & Reading has placed an order for 6 Mikado locomotives with the Baldwin Locomotive Works.

The Central Railway of Brazil has ordered six ten-wheel locomotives from the American Locomotive Company.

The Minnesota, Dakota & Western has three locomotives for sale, and is also in the market for three locomotives.

The Sumpter Valley is contemplating the purchase of two 45-ton locomotives and has one 28-ton Mogul for sale.

A bill authorizing the construction of new railroads in Alaska has been reported to the House judiciary committee.

The Chicago & Western Indiana has ordered four Moguls and six switchers from the Lima Locomotive Corporation.

The Pennsylvania is reported to have placed an order for forty-six Atlantic type locomotives to be built at its Juniata shops.

The Buffalo, Rochester & Pittsburgh has placed an order with the Cambria Steel Company for 3,000 steel underframes.

The San Pedro, Los Angeles & Salt Lake has ordered three switching locomotives from the Baldwin Locomotive Works.

The Dorado Extension Railway of Colombia has ordered two Prairie type locomotives from the American Locomotive Company.

The Great Northern has ordered 5,000 tons of rails from the Lackawanna Steel Company, and 5,000 tons from the Bethlehem Steel Company.

The Central Railroad of New Jersey has ordered ten ten-wheeled locomotives and five switchers from the Baldwin Locomotive Works.

The Buffalo, Rochester & Pittsburgh is said to be in the market for 1,000 fifty-ton gondola cars, 1,000 box cars, and 1,000 fifty-ton hopper cars.

The Wabash has started work on the new yards at Granite City, Ill. A roundhouse, turntable and shop will be built at a cost of about $100,000.

The Chicago, Milwaukee & St. Paul will soon start on an order for 25 consolidation and 10 Mikado locomotives at the West Milwaukee shop.

The Grand Trunk will build an addition to its engine house at Biggar, Sask., and it is said that building of shops at that place is also contemplated.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered six consolidation and four Pacific type locomotives from the American Locomotive Company.

The Chicago & North Western is in the market for twenty-seven smoking cars, thirty steel baggage cars, thirty-six steel coaches and eight steel postal cars.

The Texas Pacific has completed about 11 out of 80 miles of relaying, with 80-pound steel. Twenty miles of new 75-pound are also to be used in relaying.

The Missouri Pacific is in the market for 100 passenger cars. The order will include chair cars, coaches, baggage cars and express cars, all to be of steel construction.

The Chicago & North Western has ordered 1,000 gondolas from the American Car & Foundry Company and 1,000 gondolas from the Western Steel Car & Foundry Company.

The Peking-Kalgan Railway, of China, has ordered five Pacific type locomotives and four Mikado locomotives from the American Locomotive Company. All will be equipped with superheaters.

The Long Island has ordered 20 express cars, 15 motor combination passenger and baggage cars, 12 coaches and 3 combination passenger and baggage cars from the American Car & Foundry Company.

The San Pedro, Los Angeles & Salt Lake has ordered eight Mikado locomotives from the American Locomotive Company. These locomotives will be equipped with superheaters and will be oil burners.

The St. John & Quebec will award contracts in the near future for the construction of an 80-mile section to be about 220 miles long, between St. John and Grand Falls, N. B. One steel bridge 1,950 feet long will be erected.

The Pennsylvania is installing automatic block signals and switches between Lewiston and Huntington, Pa. They are electrically controlled. When this is completed, all traffic running between Pittsburgh and New York city will be controlled under this system as soon as this piece is completed.

The Kansas, Oklahoma & Southwestern was organized some time ago and now has plans that call for building from Caney, Kan., southeast via Wann, Okla., Delaware and Nowata, to Vinita. The line will have maximum grades of one per cent., with six degrees of curvature. A contract was given last year to the Continental Construction Company, Caney, Kan., to carry out the work, which calls for handling 25,000 cubic yards to the mile.

The Florida East Coast Railway has just received 12 new locomotives from the American Locomotive Company, Schenectady works. The new engines are of the Pacific type, equipped with Schmidt superheater, piston valves, Walschaerts valve gear, type E Pyle National Electric Headlight, Westinghouse E-T brake equipment, etc. The cylinders are 22 x 26. They are to be used in both freight and passenger service. Twelve more will arrive in November.

The Latest.

The very latest scheme for reducing the number of fatalities in railway collisions is to place the baggage car in the hind end of each passenger train to act as a buffer. The idea is in line with the remarks of a colored sleeping car porter who wished to know "Why dey don't leave off de hind cyar, which always gets mashed in a collision?"

A Comfortable Finish.

At the last Traveling Engineers' Convention Mr. J. M. Daly, General Superintedent of Transportation of the Illinois Central, delivered an interesting address on Tonnage Rating, in which he related an anecdote told him years ago by Angus Sinclair. Mr. Daly mixed the story a little, which originally was:

When railways were first opened in Scotland there was decided prejudice against them among the educated classes, and difficulty was experienced in finding men to take such positions as station agents and others that called for some business knowledge. The most intelligent class of workmen in these days were weavers. Studious habits were fashionable among the old hand loom weavers, many of them having been in the habit of reading Latin and Greek works to lighten their monotonous occupations. Another peculiarity among weavers was that they were keen politicians, many of them being Chartists, a semi-socialistic organization formed to conserve popular rights. Not a few of them were also free thinkers.

The first station masters were largely selected from the weaver class. David Falconer had been for many years station master at Marykirk, but old age overtook him, also an attack of pneumonia, and David was reported to be about to pass into the bourne from which no traveler returns.

David had not connected himself with any religious denomination, but it was the duty of the parish minister to visit the sick and he called upon David with the view of giving comfort and spiritual aid.

"I'm verra sorry to find you in this condition, David," said the Rev. Mr. McGowan, "will you permit me to read a chapter of the Word for your edification?"

"No, I dinna want any Bible reading; don't believe it."

"Noo, David, will ye let me offer a prayer in this trying moment?"

"No, dinna want any praying on ma account."

"This is really too bad David, you are passing fast away with nothing to comfort you on the long journey. Can't I do anything to comfort you?"

"We'el. Minister, if you can start an argument wi me, I think it might help to make me pass away happy."

A poet who has been known to tell the truth recounts this story of his little daughter. Her mother found her expounding the origin of the sex to her family of dolls. "You see, children," she said, "Adam was a man all alone, and was very lonely, so God put him to sleep, took his brains out, and made a nice lady of them."

Books, Bulletins, Catalogues, Etc.

Locomotive Boiler Construction.

A new edition of this standard work by Frank A. Kleinhaus has just been published by the Norman W. Henley Publishing Company, New York. It extends to nearly 500 pages, with 350 illustrations and 5 folding plates. As an educational work it is not surpassed by any other book on the same subject. The locomotive is taken up in complete detail from the first mark in the first sheet to the finished boiler. All types of boilers are illustrated and described. Riveting, punching, dies, and all means and methods used on boiler constructing are described with a degree of clearness that meets the requirements of the beginner as well as the most skilled workman. Boiler inspection laws, examination questions with the answers are appended, and it would be difficult indeed to imagine anything in connection with boiler construction that is not clearly described in the new edition of this excellent work. Price $3.

National Tube Company's Bulletin.

The "Manufacture and use of Shelby Seamless Steel Tubing" is the subject of an admirable treatise prepared by Mr. J. H. Nicholson and Mr. Emil Holinger, and reprinted by the National Tube Company, Pittsburgh, Pa. The publication extends to forty pages, and is printed on superfine paper and profusely illustrated. The appliances used in the manufacture of tubes are fully described. It may be stated that the company employs about 17,000 men, and they have modern, self-contained plants, and control all parts of the operation of manufacture from the ore to the finished product. About 3,000,000 tons are used in the pipe industry each year, and the demand is steadily increasing. Almost one-third of this immense tonnage is produced by the National Tube Company. Besides the special bulletin referred to there are a large number of other interesting publications bearing on the company's fine products, copies of any of which may be had on application.

Staybolts.

The Flannery Bolt Company, Pittsburgh, Pa., are issuing a series of very instructive pamphlets particularly describing the correct methods of applying the flexible staybolts. Illustrations are given showing correct methods of aligning staybolts, and also of incorrect methods that have crept into use. The necessity of squaring all bolts with the firebox sheet is clearly pointed, and a series of questions and answers give the pamphlets a high educational value. Among the pamphlets one dealing with the "Breakage of Staybolts," contains the report of a demonstration of a Michigan Central engine with adjusted staybolts which is quite interesting and deals tentatively with the bolt adjustment. Copies of these interesting pamphlets on the subject of staybolts will be sent on application.

National Spring Plug Cock.

The National Tube Company, Frick Building, Pittsburgh, Pa., are meeting with much success in the growing demand for the spring plug cock, which was designed to overcome the disadvantages of the ordinary style, or through-plug cock. As is well known when the plug becomes loose in the ordinary type of cock the workman frequently injures the plug in tightening it. Then, again, should the plug become cemented to the body, it is common practice to loosen the nut and drive up the plug with whatever tools are at hand, no special care being taken to properly adjust the plug afterward. In the National plug cock, the plug is inverted with a spring at the bottom which constantly presses the plug firmly against the seat. In the event of the plug sticking after long service, it may be readily loosened by a slight blow on the top, after which it is instantly reseated by the action of the spring. The article is fool proof, and cannot be tampered with by incompetent workmen.

Irish Channel Railway.

The proposition to connect Ireland to England, by means of a submarine tunnel or floating bridge or other scheme has engaged the attention of engineers for many years. In view of the distance to be traversed, the work seems too vast for present attainment, but as scientific progress is so rapid it is not outside the pale of engineering consideration to contemplate a tunnel under the Atlantic or a flight to the moon. Mr. H. G. Tyrrell, an eminent Chicago engineer, presents the latest contribution to the spanning or tunnelling of the Irish Channel. From Black Head in Ireland to Port Patrick in Scotland is 23 miles. Mr. Tyrrell has four methods of getting over this: a continuous embankment or causeway—a submarine tunnel—a submerged floating tube or viaduct—or a bridge. All that is needed now is the money.

Removal.

The Collins Metallic Packing Company, manufacturers of Collins metallic packing and Collins wheel flange lubricator, in view of the growing demand for their fine products, have removed to more commodious quarters at 56 and 58 N. Second street, Philadelphia, Pa., where the company's works and offices are now located.

South African Railways.

The general manager of the South African railways has forwarded to us a copy of his annual report which has just been published and which extends to nearly 200 pages. From the report it appears that forty-two new locomotives were placed in service last year, and there are now 1,454 locomotives, of which 1,426 are of the 3 ft. 6 ins. gauge type, and twenty-eight of the 2-ft. gauge. The average tractive force is 21,103 pounds. Of the 3 ft. 6 ins. gauge of locomotive, 105 were in course of construction during the year. Of the locomotives placed in service during the year 11 were of the Mallet type, and their operation is reported to have considerably reduced working costs. The replacement of castor oil by cheaper oil for lubrication is meeting with success, as the previous reports showed that the wear and tear on the engine bearings is greater with castor oil than with the mixed oils now used. The number of wagons, which is being rapidly added to, amounted at the end of last year to 21,932 with a carrying capacity of 414,883 tons.

Graphite Paint.

Apart from the universally acknowledged merits of Dixon's Graphite where used as a lubricant there are an endless variety of uses to which the Dixon Graphite productions are put. Among these Dixon's Silica-Graphite Paint is an example. This compound is rapidly becoming the standard protective paint for railroads. Its recent application to the new twin water tanks at the pumping station of the Pennsylvania Railroad near Plainsboro, N. J., is a shining example. Each of the tanks has a capacity of 100,000 gallons, and the contents are piped to water pans situated along the tracks, which in turn supply the water to trains while under speed. Many tests by the Pennsylvania of different kinds of paint have clearly demonstrated to the satisfaction of the company's engineers the superiority of Dixon's Silica-Graphite paint, which has the double merit of a finely-polished appearance and of enduring quality.

H. W. Johns-Manville Co. Opens Branch in Galveston, Tex.

The spirit of business enterprise which characterizes this aggressive concern is once more evidenced by the opening of a new office and warehouse in Galveston, Texas. The H. W. Johns-Manville Co. now boasts three offices in the Lone Star State, viz., at Houston, Dallas and Galveston. At the last named place, in a modern brick warehouse of large proportions, will be consolidated the stock for distribution to the different offices and throughout the firm's Texas territory.

The H. W. Johns-Manville Company is among the country's largest houses dealing in roofing, building materials, packings, pipe coverings, insulating materials and electrical goods, and is the world's largest manufacturer and distributor of asbestos goods. This concern owns extensive asbestos mines in Danville, P. Q., Canada, and has nine factories located in various cities throughout the United States.

Metallic Packing.

The Edwards type of metallic packing, specially designed for superheat and high pressure engines, and manufactured by the Jerome-Edwards Metallic Packing Company, Railway Exchange Building, Chicago, Ill., is the result of several years' experimenting and after repeated trials in several Western railroads has been found to be absolutely reliable, and will not melt or cut the rod under the most severe service. A descriptive bulletin has just been issued by the enterprising company, copies of which may be had on application. A good proof of the enduring qualities of the packing is found in the fact that it has been adopted as the standard in the Chicago, Milwaukee & St. Paul Railroad.

Crude Oil as Engine Fuel.

It is estimated that more than 32,000,000 barrels of crude oil were used by railroads of the United States for fuel in 1912. This was an increase of more than 4,000,000 barrels over 1911. During the last few years, crude oil has replaced coal for fuel on the locomotives upon many of the railroads in Texas, Oklahoma and Louisiana.

The total mileage of railroad now operated with fuel oil is about 28,000 miles. The adoption of oil for fuel by many of the roads has added greatly to the comfort of the traveling public, has lessened the labor of the firemen, and has greatly reduced the cost of operation. More than 1,200 oil burning locomotives are in use on the Southern Pacific and more than 800 on the Santa Fe.

Removal Notice.

The general offices of the American Steel Foundries, Chicago, Ill., with headquarters formerly in the Commercial Bank building, has removed to more commodious offices in the McCormick building, 332 South Michigan Avenue, Chicago, Ill.

Announcement is made by the Wm. H. Wood Loco Fire Box & Tube Plate Company that the American Locomotive Company and the Baldwin Locomotive Works will manufacture their fire boxes under a reasonable royalty, whenever specified.

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HARRY A. KENNEY,
Gen'l. Mgr.

Sworn to and subscribed before me this seventh day of October, 1913.

OLIVER R. GRANT,
Notary Public No. 1398, New York County. Commission expires March 30, 1915.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVI. 114 Liberty Street, New York, December, 1913. No. 12

The Standard Locomotive Stoker

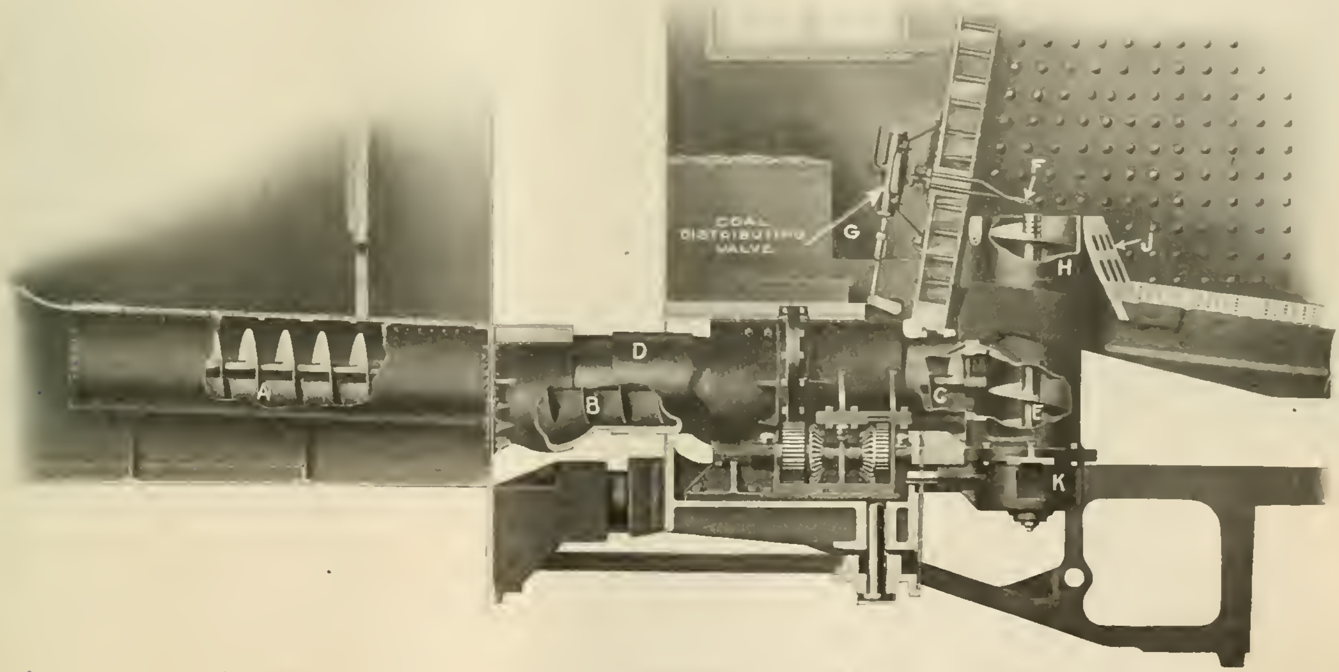
The persistent demands of the various railroads for increased weight of trains is presenting a problem of no small importance to the mechanical departments and to those responsible for the designs of the locomotives necessary to meet these conditions.

Owing to the limits within which the modern locomotive must be constructed the difficulties in obtaining the necessary proportion of the relative parts demands considerable thought and ingenuity; but or "experiments," but have entered the ranks of the regular locomotive power, and are daily carrying their burden with no special attention or comment.

One of the most important problems in connection with the development of these heavy locomotives was the question of fuel consumption, and whether the coal requirements of such a locomotive would be within the physical possibility of a human stoker.

Experience has shown that locomotives mand for firing the heavy locomotives by mechanical means, and considerable engineering skill and ingenuity have already been displayed in the several devices developed for the purpose.

One of the latest and undoubtedly one of the most successful of these devices is represented by the Standard Stoker, which, considering the time it has been in operation, has shown such exceptional results and possibilities that its success is unquestionably assured.



THE STANDARD STOKER; SHOWING ARRANGEMENT OF CONVEYOR, JETS AND GRATES.

at least one important limitation appears to have been successfully removed, and that is the physical limitation of the fireman.

The increased tractive power necessary to haul the enormous trains over the ruling grades has resulted in the development of designs which a few years ago would have been regarded as "freaks," but which today are officially performing the work for which they were originated, and are no longer regarded as "freaks" of large modern design cannot be fired upon the same basis as those of a few years ago; that is to say, a man cannot endure the demand upon his physical capabilities for anything approaching the same period; owing to the increased labor necessary to maintain a satisfactory steam pressure, with the result that these large locomotives have to be double crewed, or the hours of toil considerably reduced.

These conditions have developed a de-

This mechanical stoker was applied to one of the heavy freight engines on the New York Central Railroad, and during the period it has been in operation has given very excellent results in the regular service in which these engines are employed.

Since the locomotive was equipped with this stoker it has operated over 6,000 miles without one shovelful of coal being put into the fire box by hand, and without a single failure having been recorded

against it, and we have been informed upon the unquestionable authority of those entirely disinterested and who have observed its performance, that no difficulty has been experienced at any time and under the most adverse conditions of maintaining the maximum boiler pressure.

In order that this device may be more thoroughly understood, we give a longitudinal section showing all the important features of this new stoker.

So far as simplicity is concerned, it would be difficult to conceive of a piece of mechanism less complex and yet capable of automatically accomplishing the manual work of a fireman.

Its operation will no doubt be immediately understood by a glance at the power, freedom from complicated parts, and possibility of breakdowns or failures.

From the tender the coal passes into what is known as the Intermediate Conveyor "B," which is flexibly connected to the Tender Conveyor and Front Conveyor "C," located on the locomotive. The Intermediate Conveyor is contained in a steel trough or housing, "D," one end of which is supported by the tender and the other by the engine, the supports being constructed on the principle of a "ball and socket" joint permit of ample freedom of movement between the engine and tender. The end-ways movement between the engine and tender is provided for by means of a sliding joint between the front end of the Intermediate Conveyor "B" and the rigid portion of the Front Conveyor "C" to which it is secured, and from which it obtains its rotary motion. This joint consists of a square shank, on that portion of the universal coupling "E" secured to the Front Conveyor "C" which fits into a corresponding square hole in the hub of the Intermediate Conveyor in which it is free to slide end-ways, but by virtue of its square shank maintains a constant rotary motion.

The coal after leaving the Intermediate Conveyor passes into the Front Conveyor "C" through the main driving gear, "F," the arms of which are so constructed as to advance the coal just as efficiently as the regular conveyor flights.

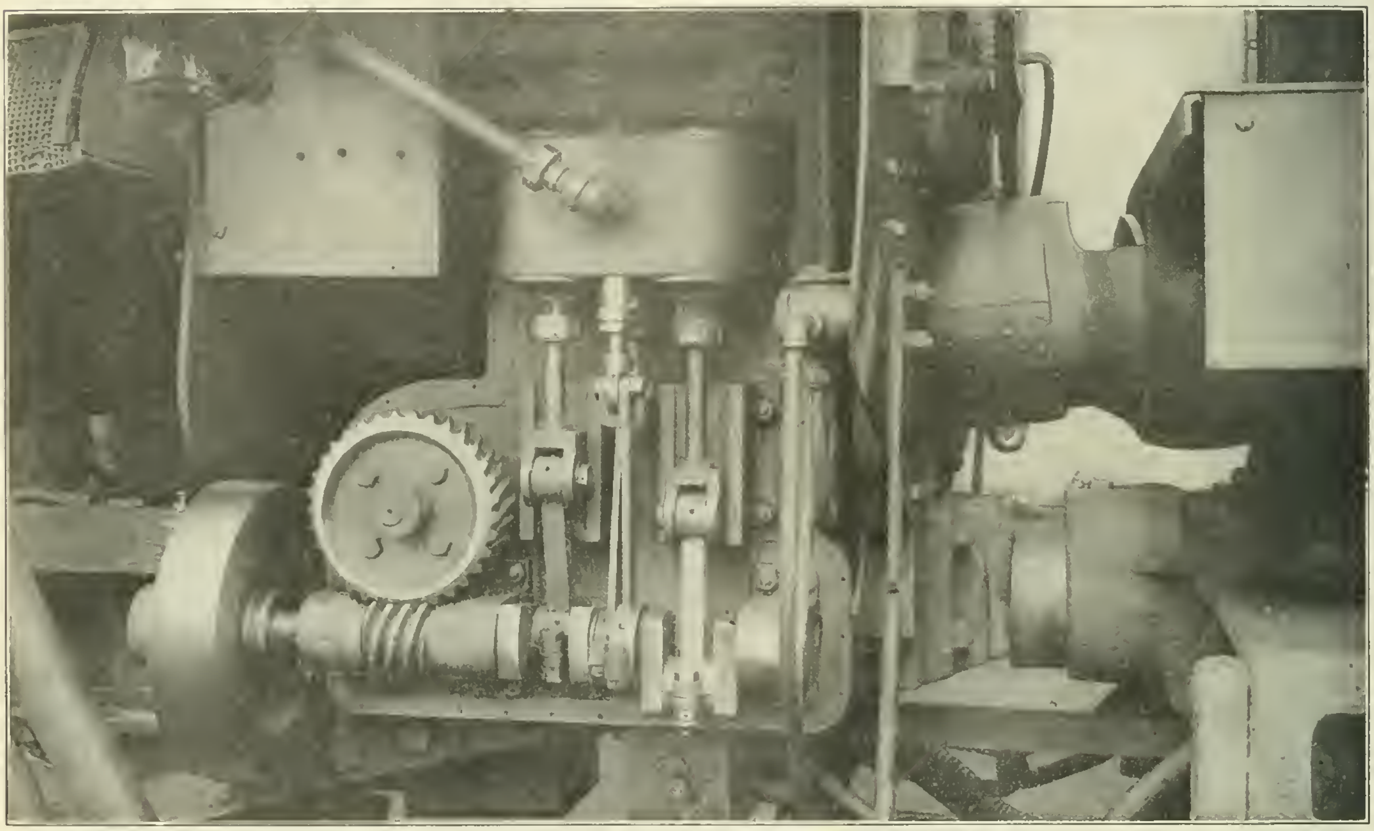
After passing through the Front Conveyor the coal enters the vertical conveyor "G," by means of which it is raised vertically to a point slightly above the top level of the fire, and from which it is evenly distributed over the entire bed of fuel.

The method of distribution is worthy of special note, and is accomplished by means of five steam jets "H" having an intermittent action controlled by the piston valve "J," which is operated through an eccentric from the main drive shaft.

The jets "H" are so arranged as to cover every section of fire box and permit of great flexibility and variation, so that any desired part of the fire is under the immediate control of the fireman.

As an example of the results obtained with this distributing device, we are authoritatively informed that the locomotive equipped with this stoker invariably runs over the division without resorting to the use of the rake and reaches the terminals with a perfectly level fire. We believe such a performance to be remarkable in the history of Mechanical Stoking.

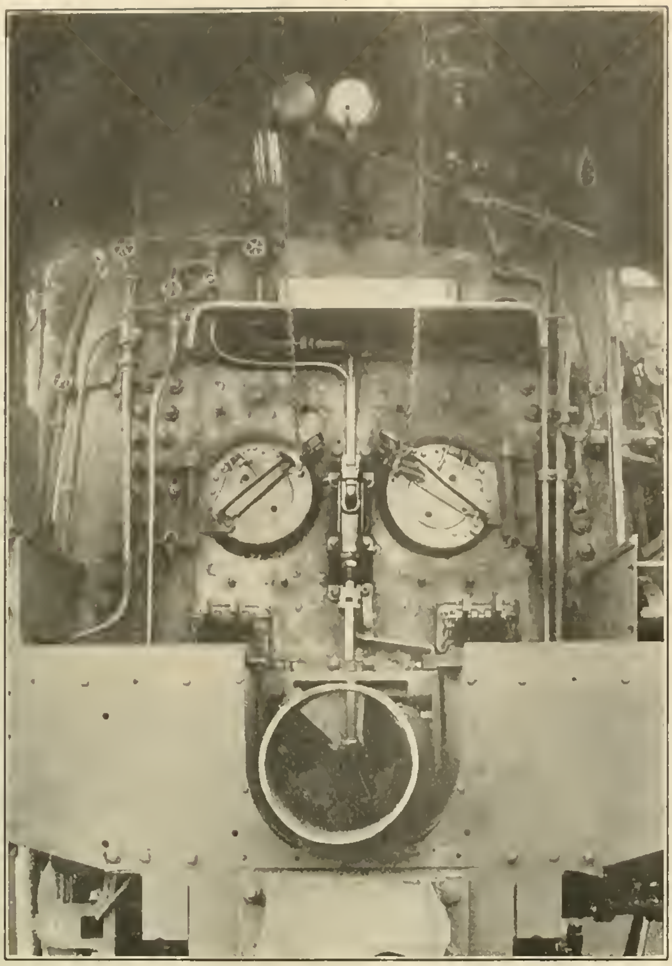
A feature worthy of considerable attention is the method employed for protecting the parts exposed to the fire located within the fire box. This at first presented an extremely difficult problem, but by persistent efforts was finally overcome by shielding the vertical conveyor housing "K" by means of a sloping or angular grate "L" perforated in much the same manner as the regular grate bars, which permit of a flow of air through



THE SMALL ENGINE ON THE LEFT SIDE OPERATES THE STOKER CONVEYOR AND THE JET CONTROL VALVE.

cut by those familiar with the subject, but in order to avoid any misunderstanding we will give a brief description of the manner in which the coal is automatically taken from the tender and distributed over the fire continuously and without interruption or assistance on the part of the fireman.

The floor of the coal space within the tender differs from those ordinarily in use in that the horizontal floor has been replaced by sloping sides, which actually form a V, at the bottom of which is located the horizontal screw or "tender conveyor" "A." This sloping formation permits of all the coal being fed into the conveyor by gravity without the use of agitators or other mechanical means, thus saving a considerable expenditure in



VIEW IN THE CAB OF A LOCOMOTIVE FITTED WITH A STANDARD STOKER.

same at all times, the cooling effect of which has been proved to amply protect this sloping grate from deterioration resulting from contact with the fire.

The existing sloping, or protecting grate at present in this engine is the one originally installed, and after long and severe service shows absolutely no indication of effects from the fire, there being every evidence that it will last fully as long as the usual grate bars.

The stoker is operated by means of a small two-cylinder vertical type steam engine, and under normal conditions the horse power required to operate the stoker and attachments thereto, including the distributing valve does not exceed 7 H. P.

The power is transmitted from the engine by means of a heavy bronze worm gear through the main driving shaft, and from which the horizontal and vertical conveyors are operated by suitable bevel and spur gearing.

The bevel gears for operating the vertical conveyor are contained in a cast steel gear case "M" partly filled with oil, located within the ash pan, and which needs absolutely no attention whatever with the exception of an occasional examination of the oil level, say every four or five days, and which may be done in a few moments by observing the indicator located outside of the frame.

Another feature of the Standard Stoker to which particular attention should be directed is the entire absence of noise when in operation as a result of all the moving parts being of very low speed and rigidity, and yet where necessary, flexibly, supported so that no rattle or vibration exists.

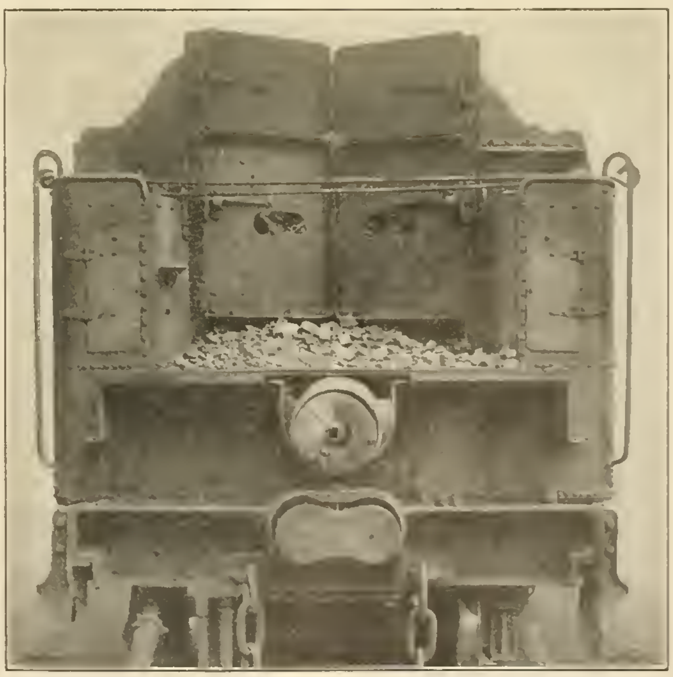
The locomotive to which the stoker is attached has been put into practically all kinds of service with the object of testing the merits of this stoker which has never failed to give entirely satisfactory results, maintaining the maximum steam pressure under all conditions of service.

During the time it has been in operation not one cent has been spent upon its maintenance, and the fact that not a single breakdown has occurred is, we believe, with our knowledge of the subject, a remarkable performance, and which indicates an exceptionally low cost of maintenance.

With a full appreciation of the severe service and unlooked for stress to which parts on a locomotive are subjected, it was decided to use no metal liable to fracture, consequently the stoker is constructed throughout of cast steel with the exception, of course, of bearings and other parts where mild or wrought steel would be appropriate. This decision, no doubt, accounts in a large measure for the entire freedom from failures or breakdowns.

The controlling valves of the stoker engine and distributing jets are conveniently located in respect to the fireman's seat, and as the operation of the stoker needs only a minimum of attention the regular duties of the fireman in observing signals, etc., are not interfered with.

The lubrication of the various parts is accomplished by means of automatic grease cups, consequently after these have



VIEW OF THE TENDER SHOWING THE LOCATION OF THE CONVEYOR.

been filled and adjusted no further attention to lubrication is necessary.

The Standard Stoker is manufactured by the Standard Stoker Company, No. 3735 Grand Central Terminal Building, New York City, with offices also at the du Pont Building, Wilmington, Delaware.

Urge Fairness Towards Railways.

A recent address made by Chairman E. E. Clark, of the Commission, to the National Association of Railway Commissioners, is significant. He told his hearer that the railroads could not provide the transportation facilities asked of them, as to freight and passengers, unless their income was increased and their credit strengthened. This meant, he intimated, a general, if small, elevation of rates. He admitted prejudice against such policy, growing out of the past high financiering and abuses of the carriers. But he said that if the carriers are to be penalized for their past sins, the commerce of the whole nation would be made the victim.

No one doubts that the railroads of the whole country are in need of extensive standardization. Their equipment and facilities are entirely insufficient to meet the daily demands upon them, not to anticipate the future. It is conservatively estimated that at least a billion dollars is required for this task, which cannot much longer with safety be delayed.

No one recognizes the situation more keenly than the average railroad head. But he knows also that it is impossible for the railroad to market bonds and securities so long as its income is, as at present, upon a problematic and fluctuating basis.

If the railroads could borrow the money they need, hypothecating their securities in return, the resulting enormous expenditures would flow into every commercial and industrial channel in America. The prosperity that now lacks a finishing touch because the railroads have, perforce, stayed out of the purchasing market would mount into unprecedented proportions. The country in general would begin to enjoy one of the most opulent eras in its history.

Reliable evidence is at hand that an era of better understanding has been reached as between the railroads and the people. The former seem resolved on a more straightforward course. The latter have punctured the pretense of the political ghost-dancers and the muck-rakers. The Interstate Commerce Commission itself appears minded to ward off old vicious practices, and to ask for a square deal for the railroads as well as the people. In view of this crystallizing situation, the railroads stand an increasingly excellent chance to dispose of their securities upon fair terms, and to administer the proceeds strictly for the rehabilitation of which they stand so drastically in need.

In the process of rehabilitation the huge sums to be expended will quicken prosperity in every channel. In the ensuing good times there will be all the splendid phenomena that characterized the flush seasons of 1905-6, without the costly reaction of 1907. The country is too well chastened to justify the fear of a repetition of that disaster.

Railroad Expenses.

In the ten years between June 30, 1902, and June 30, 1912, the total trackage in miles increased 31 per cent.; the number of locomotives, 48 per cent.; the number of freight cars, 42 per cent., and the number of passenger cars 37 per cent. The total revenue increased 63 per cent., but total operating expenses increased 76 per cent. The net operating revenue, excluding taxes, increased 42 per cent., but taxes increased 107 per cent. Wages paid to employees increased 87 per cent. These figures tell the story and account for much of the reason why a considerable amount of stocks and bonds pay no interest or dividends.

Sunset-Central Strike.

The trainmen of the Sunset-Central or Atlantic division of the Southern Pacific alleged that they were suffering from sixty-seven grievances, some of them dating back two years. The organizations were the Brotherhood of Locomotive Engineers, the Brotherhood of Locomotive Firemen, The Order of Railroad Trainmen and the Order of Railroad Conductors.

Demands were made for settlement of the grievances complained of, and the requests being refused a strike was instituted on November 13, and continued for five days before the company decided to grant the trainmen's demands, to meet a federated committee of the four unions. The settlement was brought about by the Federal Board of Mediation and Conciliation.

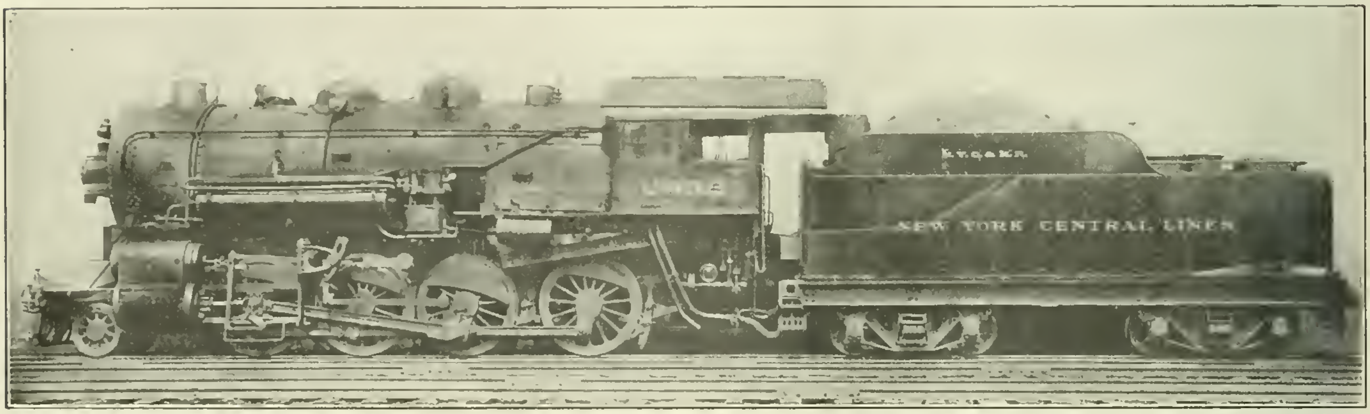
Terms of settlement were suggested to both sides from Washington, November 17, and immediately after receiving notification that the Southern Pacific had acceded the heads of the unions wired their acquiescence, and in a body called on W. B. Scott, president of the Sunset-Central, who received them along with the information that the "strike was off."

The unions say they won all they contested for—recognition of a joint committee and united adjustment of differences.

Discord on the Pennsylvania.

A meeting of the employees of the New Jersey division of the Pennsylvania Railroad was held at Trenton, N. J., to protest against the new Pennsylvania Mutual Association, an organization of Pennsylvania employees embracing all departments including the leading officials.

Railroad men of the various brotherhoods took an active part in the meeting, and strong expressions of opposition to the new organization were uttered and the charge was made that the real purpose of the organization was to wreck the existing brotherhood.



CLASS G 6 F CONSOLIDATION LOCOMOTIVE, NEW YORK CENTRAL, FITTED WITH A STANDARD STOKER.

Improved Geared Locomotive

Among the more important patents secured last month in connection with locomotives improvements, are geared locomotives invented by Mr. Samuel Vauclain, Mr. Morris Linton, and Mr. George Henderson, all of Philadelphia, Pa., are recorded. The object of the invention is to construct a geared locomotive on the general principles of an ordinary locomotive, as far as the steam engine is concerned, and to provide a connection to each pair of wheels and axles so that all will be operated by gearing of the "rolling contact" type between the teeth of the gears in mesh.

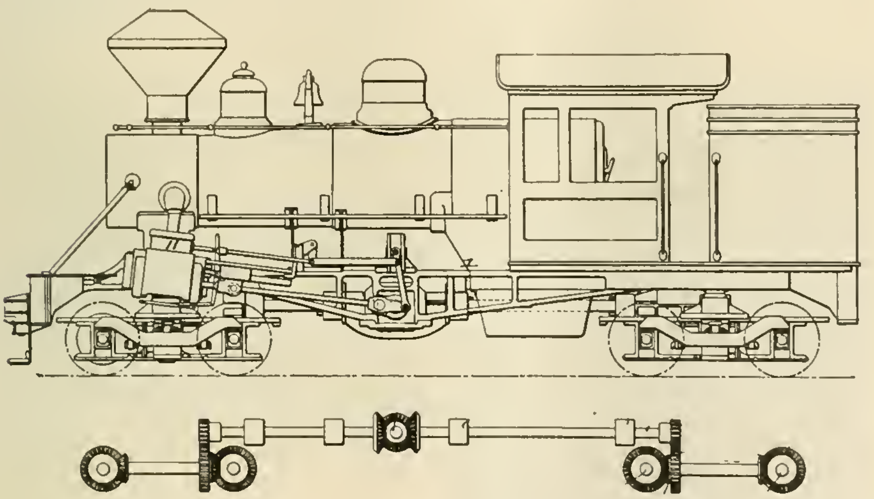
The further object of the invention is to construct a locomotive to be driven by gears running in oil, insuring maximum service and minimum wear and repair. Another feature is to construct the locomotive so that the gearing can be diconnected to enable the locomotive to be shipped on its own wheels and to provide means for readily assembling the gearing.

As shown in the accompanying illustration, the trucks are pivotally mounted under the frame and support the entrie structure. The details of these trucks may be made in any suitable manner. The side frames are made in the form of a truss. A cap forms a continuation of the lower member at the opening for the box for the transverse shaft, the deepest portion of the truss being at this point. The frame also supports the cylinder casting and is extended forward, to support the bumper and at the rear to carry the rear portion of the locomotive. The bearings for the crank shaft form part of a casing and extend through the side frames, so that the ends of the crank shaft are properly supported. Within the casing and secured to the shaft is a beveled gear wheel which meshes with wheels adapted to bearings mounted in lateral extensions. The bearings are made in halves having flanged bushings, and, when a position is located between the casing and the rear of the beveled wheel on the shaft. The bearings are not put in position until after the shafts with their gears are in place. The casing, enclosing the gears forms a receptacle for oil which is closed by a cap, so that the gears run in oil at all times.

It will be noticed that the shaft and two axles are all on the same horizontal plane, and ordinary bevel gears of the "rolling contact" are used. The gearing is so constructed that the two parts of which it is composed are free to turn independently so that the wheels accommodate themselves to the track.

It can be readily seen that a locomotive of this type is particularly adapted for logging and other rough roadways where flexibility is absolutely necessary. In transferring the locomotive instead of mounting it on a car or upon special trucks, the cap of the casing is removed and the gear is then moved longitudinally on its axle and out of mesh with the driving pinion. The same adjustment is made on the other axles of the engine so that all the axles are free to turn without turning the driving mechanism, and the locomotive can be transferred on its own wheels, the same as an ordinary car.

Both the forward and rear truck are constructed in the same manner, and the gearing of the forward truck is a duplicate of the gearing on the rear truck, and while the improvements described refer to a locomotive having two pivoted trucks in which the axles are geared to the driving mechanism, a locomotive may be so constructed as to have more than two trucks, if necessary, according to the power of the locomotive and the length of the frames. It is expected that a locomotive of this type will be in service at an early date and its performance will be watched with interest.



IMPROVED GEARED LOCOMOTIVE.

Charles Dickens on First Mountain Railroads.

During the three first decades of last century when the people were striving to devise means of transportation into the great unoccupied spaces on the North American continent, most of the States were willing to aid improved methods of transportation, but canals were the favorite arteries of travel. This came from the success of the New York & Erie canal.

It came about that the people of Pennsylvania as represented by Philadelphia wished to connect the Delaware and Schuylkill rivers with the upper waters of the Ohio, and a long controversy was carried on concerning the practicability of tunneling the Allegheny mountains for the use of a canal. That scheme was abandoned in favor of the Portage Railroad, by which trains were carried over the mountains.

CHARLES DICKENS' DESCRIPTION.

Charles Dickens, describing his trip over the parent line of the Pennsylvania system, in 1842, said:

"It was very pretty, traveling thus at a rapid rate along the heights of the mountain in a keen wind, to look down into the valleys full of light and softness; catching glimpses through the tree-tops of scattered cabins; children running to the doors, dogs bursting out to bark, whom we could see without hearing; the terrified pigs scampering homeward; families sitting out in their rustic gardens; cows gazing upward with stupid indifference; men in their shirt sleeves looking on at their unfinished houses, planning out tomorrow's work, and we riding onward high above them like a whirlwind. It was amusing, too, when we had dined and rattled down a steep pass, having no other moving power than the weight of the carriages themselves, to see the engine, released long after us, come buzzing down alone, like a great insect, its back of green and gold so shining in the sun that if it had spread a pair of wings and soared away no one would have had occasion, as I fancied, for the least surprise. But it stopped short of us in a very business-like manner when we reached the canal, and before we left the wharf went panting up this hill again, with the passengers who had waited our arrival for the means of traversing the road by which we had come."

General Correspondence

First Ten-Wheeler.

Editor:

In November's Railway and Locomotive Engineering I find that you give credit to the firm of Hinkley & Drury for having built and put in service the first ten wheeled locomotives, that is, six wheels connected, with four-wheel truck in year 1851. Pardon me if I correct you in the matter. In the spring of 1845 or 1846—I think the former—I quit the shop of M. W. Baldwin & Co., where I was learning to be a blacksmith, and as the P. & R. R. R. was just fitting up a new shop at Reading and were hiring all the men they could get I wrote to the foreman blacksmith for a job and got it.

One morning, a day or two after I went to the shop, there was quite an excitement kicked up; men were running out to the tracks, I went also and was just in time to see a new engine, decked out with flags and wreaths of flowers She had three pairs of wheels, drivers, on four-truck wheels. Cylinders were horizontal and covered with brass. She had the regular eight-wheel engine train of 85 four-wheel coal cars, each carrying an average of five tons. On a "dry rail" she handled her train well, but slipped badly on wet or frost.

When Jas. Millholland took charge as master mechanic he set the truck about a foot ahead and took out the first pair of driving wheels. After a few trips he put the drivers back, setting the truck ahead, reducing the propensity to slip a great deal.

This engine was called the Chesapeake and was built by the Norris firm on Bush Hill. I don't remember whether by Wm. Norris & Sons, or the later firm of Norris Bros. She was a very serviceable engine; was used mostly on freight. Hinkley & Drury did not build the first ten-wheel engine, but it is more than likely theirs was the second.

E. J. Rauch.

New York, N. Y.

Editor:

You know that history is made from data in books, technical journals, and newspapers that are being published and to be good and useful history it must be "true." On page 393 of the Railway and Locomotive Engineering of yours there appears what was intended for history, "First Ten Wheeler by Hinkley Locomotive Works in 1851." Septimus Norris in 1846 patented and built for the Philadelphia & Reading Railroad several of that type and in 1848 Rogers built one for the Savanilla Railroad and also for the New York & Erie Railroad at the same time, and the ones for the Erie had flanged tires on all driving wheels.

I would like to see this matter recorded and so maintain your past record in producing good history.

Ancient.

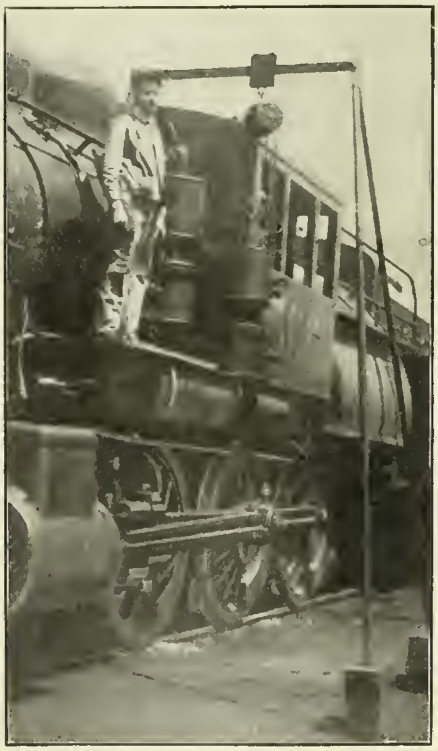
Editor:

In your November issue you state that the first ten wheeler (4-6-0) was built by Hinkley in 1851.

Have you not overlooked Norris Brothers famous "Chesapeake" of 1847, built for and operated on the Philadelphia & Reading R. R.?

C. H. Caruthers.

Yeadon, Pa.



CRANE FOR AIR PUMPS.

Portable Crane.

Editor:

In the November issue of Railway and Locomotive Engineering there is a description and illustration of a very handy jig for handling cylinder heads which should meet with general approval and adoption wherever practical.

Enclosed is a photograph of an appliance that has been in use in the Reading roundhouse at Wilmington, Del., for several years and has given very satisfactory service in removing air pumps from engines when it is not convenient to take the engine to the engine house where suitable cranes are located.

It will be readily noted that the appliance is simple in construction and may readily be adopted to any situation, as its portability is its prominent feature.

If not sufficiently clear to any interested reader fuller details will be gladly furnished on application to the undersigned.

Engine House Foreman.

P. & R. R. Roundhouse,
Wilmington, Del.

Hard Working Slide Valves.

Editor:

In reading over your recently published report of the annual convention of the Traveling Engineers' Association, I noticed that Mr. W. R. Davis stated that on locomotives using superheated steam there was no trouble with the slide valves, but that it was a difficult matter to keep the quadrant tight. Mr. Davis is evidently not aware that many more tons could be hauled over the road but for the severe friction incident to the use of slide valves. Then there is invariably considerable extra expense in trying to lubricate slide valves, and the records of an extended period will show trains delayed, broken eccentric straps, and other troubles all directly traceable to hard working slide valves. To lessen the trouble some recommend running with a light throttle and longer cut-off thereby lessening the valve friction. The slide valves are the cause of many of the larger locomotives that are not using superheated steam showing to little advantage, and do not come up to the required tonnage. A locomotive on which the valves work easily, and where the piston and valve rod packing is tight, will show a saving in fuel and running repairs.

Cincinnati, Ohio. R. H. Williams.

Running a Locomotive in Cuba.

By Dorr Benn, Loco. Engineer.

Editor:

The experience that an engineer has in running a locomotive in the largest, richest and most beautiful island of the West Indies for over two years is an experience one cannot forget.

Cuba is 825 miles in length, the greatest width about 120 miles, and the narrowest about 20 miles. The population is 2,250,000. The railway mileage is over 3,000 miles of steam railroads, and 175 miles of electric lines. Since the Spanish-American war the Cuba company railroad has constructed over 800 miles of road, connect-

ing Santa Clara, the eastern terminus of the United Railways of Havana with Santiago De Cuba, on the southeast coast of the island and is the chief city in importance in the eastern part of the republic.

For nearly 400 miles this railroad runs through the heart of Cuba. It opened its system in 1902. It is the most important road in Cuba from more than one point of view. It serves the Republic's three largest provinces, Oriente, Santa Clara and Camaguey, which constitute seventy-five per cent. of the total area of the Republic.

The desirability of a railroad connecting Santiago, Camaguey and Eastern Santa Clara with Havana, the seat of government, was an achievement made possible through the energy of Sir William Van Horn.

The road is a standard gauge and similar in construction and equipment to the best lines in the United States. The cleanliness of their engines and passenger coaches, as many of the coaches are solid mahogany. Discipline is manifested in all departments and the employees are courteous and polite. But a railroad man to leave the States and take a position as locomotive engineer is up against a tough proposition.

The time card, book of rules and train orders are all in Spanish and the operation or movement of trains is by the "Via Libre" system, or English method of running trains. This system is very efficient and safe as a head on collision is almost unknown on this line of road. There are many things disagreeable owing more to the unfamiliar methods employed by these people in doing things, but the longer a man stays the more familiar and congenial things become. Getting what you want to eat and the way you desire it cooked is a problem at times on the road a new man is confronted with, especially when he is hungry. A

RAILWAY STATION, CAMAGUEY, CUBA.

bridges are built of steel, masonry and concrete and the road bed generally rock ballasted. A daily passenger and freight service is maintained between Santiago and Havana, the passenger trains have first class sleeping and observation cars and the route traversed is unsurpassed as to scenic beauty. A through train leaves Havana at 10:10 P. M. every night over the tracks of the United Railways of Havana to Santa Clara and then over the Cuba Railroad to Santiago, arriving at Santiago at 9:30 P. M. the following night.

The motive power is good. The engines are American build with all modern improvements. The general shops are located at Talleres on the outskirts of Camaguey, where also are located the general offices of the company.

One is struck with the general appearance of neatness about the shops, yards and depots of the company as well as the cup of coffee and a piece of bread the size of your fist is all they eat for a morning meal. The men work on until breakfast, 11 a. m., and then it is mighty difficult at times for a trainman to get a meal at that hour down through the jungles, and often it is late in the afternoon before a warm meal is to be had. However, many of the trainmen cook in the caboose, but the Cuban dishes are not relished by the ordinary Americans served up by the boys in the caboose.

The sleeping is altogether done in hammocks instead of bunks or beds, consequently every employee carries his hammock and blanket with him on the trip.

The rails at night become quite slippery owing to the heavy dew—and the tall grass can be reached from the cab window in many districts.

As to labor organizations there are none. A movement to organize the system on the A. R. U. plan was made a few years ago. A strike was inaugurated, but the bottom dropped when the crucial test came by threats of discharge and intimidation and fear of losing their

MODEL TEN-WHEELER.

positions and having no confidence in the staying qualities of their own members, coupled with the fact that \$125 or \$135 was a big wage to the average Cuban per month more than overbalanced the long hours, hard work and the "fine" system of discipline "paying for what you damaged," and you either had to pay or get out, did not measure up from the Cuban's viewpoint sufficient grounds for a contest where duplicity was fraught with great danger among their own members.

However, Cuba like all other civilized nations will wake up in the near future and find real live railway orders improving conditions under which men work and live.

Model Locomotives.

Editor:

Enclosed are some photographs of a model railway system and rolling stock built and operated by me. The track is 753 feet long. There are two bridges and ten switches. There are three locomotives and nine cars. The two ten-wheeled locomotives are patterned from Nos. 25 and 39 on the Colorado Midland railway. The Atlantic type locomotive is

TWO MODEL TEN-WHEELERS.

modeled after No. 1040 on the Rock Island line. The locomotive is about 150 pounds weight. The boiler is of six-inch pipe, and the cabs are made of sheet iron. The Atlantic engine has valves of the Walschaerts type.

I commenced building this model system six years ago at the age of twelve, and it is now finished and I am filling my leisure time with the complete civil engineering course in a correspondence school. RAILWAY AND LOCOMOTIVE ENGINEERING has helped me a great deal. It is the most interesting and practical paper of its kind published.

WALLACE L. WISTER.

Colorado Springs, Colo.

Sinclair's Locomotive Engine Running.

EDITOR:

A traveling engineer who took several months' leave of absence to go about selling that splendid help for enginemen, "Locomotive Engine Running and Management," by Angus Sinclair, once remarked to me: "The book reads like a story and is the finest help over all difficulties." I never forgot that remark, and have found it true on many trying occasions. Not only has the book helped many enginemen over present difficulties; its teaching has sent them into high positions they never would have reached but for the spirit of self help inspired by the book. When Daniel Willard, now president of the Baltimore & Ohio Railroad, was general manager of the Erie, I heard him say that much of his success in life had been due to the inspiration of Sinclair's book.

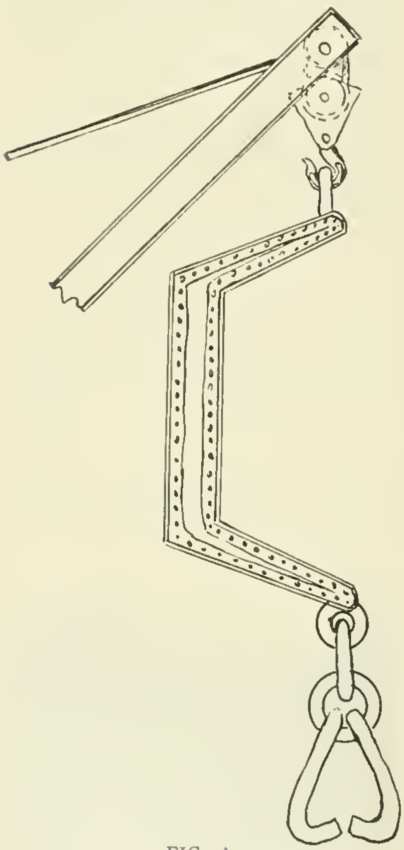


FIG. A.

As the engineers and firemen of today need help from the study of good books, I have felt duty-bound to write these remarks. No one could find a better Christmas present for a boy or an ambitious fireman.

ROAD FOREMAN.

Pittsburgh, Pa., November 14, 1913.

[After being nearly twenty-five years in circulation and having undergone three revisals, this book has still a steady sale through this office.—Ed.]

CENTRAL VERMONT SWITCHER AND FLOATS.

More Floats.

EDITOR:

I notice in the November RAILWAY AND LOCOMOTIVE ENGINEERING an industrial float that was put out by the employees of the Bessemer System, and I am inclosing you a photograph of an engine and two floats, one furnished by the boilermakers and the other by the car department. This engine ran down the main street of St. Albans on the one hundred and fiftieth anniversary of the signing of the town charter, in charge of one of our veteran engineers, Mr. F. McCarthy. This is one of our small switch engines used in service every day.

H. J. HAGUE.

Central Vermont Ry.,
St. Albans, Vt.

Hoisting Appliance.

EDITOR:

Enclosed are sketches showing details of a hoisting appliance which is readily adaptable for lifting heavy castings out of a box car. Very frequently heavy parts of mechanical appliances are transferred from the main shops to distant roundhouses in the regular course of maintaining the necessary running repairs, and the appliances shown in the sketches work very satisfactorily without the risk of injury to the box.

Fig. A shows the hoisting appliance and Fig. B shows a special box made for transporting material as already referred to. It will be noted that the corners of the box are strengthened by bolts extending the entire length of the box, the bolts passing through straps at both ends of the box. The box will be found especially servicable in conveying Pyle National and American Headlight equipment, armatures and other appliances.

J. G. KOPPEL.

Montreal, Canada.

An Engine Driver Sent to Jail.

EDITOR:

On September 2, a rear end collision happened between two trains on the Midland Railway of England, at a place called Aisgill, where sixteen lives were lost. The engine driver of the colliding train was Samuel Caudell, who was accused of running past several danger signals. The excuse made will strike American railway men as being extraordinary, for he was out on the running board oiling the machinery when the signals were passed. He was tried for manslaughter and sentenced to two months imprisonment. The judge in the course of his remarks in passing sentence remarked:

"The time may come when locomotive engines may be invented which will act automatically, when it will require no human hand to oil them, attend to the injectors or the fires or boilers; but until that is possible, and so long as a man accepts the responsibility of driving an engine which does require care and attention, so long must that man take care to perform his duty, having regard to the responsibility which rests upon him."

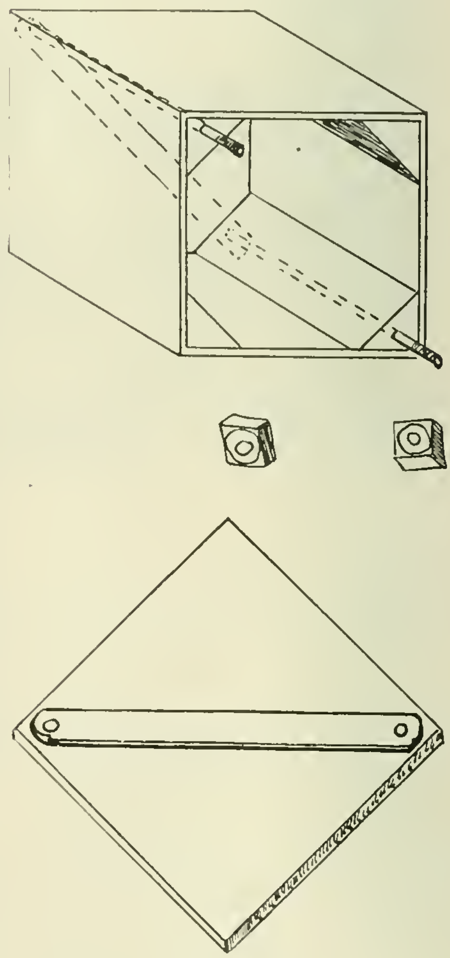


FIG. B.

Many of the British railway men are indignant over the verdict. Mr. J. E. Williams, general secretary of the union, said, after a meeting in London of a sub-

committee of the executive committee: "We are staggered, and the matter is still receiving our serious consideration."

Mr. J. H. Thomas, M.P., assistant secretary of the union, said: "We think the verdict monstrous and we are indignant to think that Candell is now lying in a felon's cell." He added that every effort would be made to have the verdict quashed.

The efforts made by organizations and influential individuals were so successful that King George granted Caudell a pardon and he was released after being in prison nine days. Mr. McKenna the Home Secretary, has received great praise for the active and kindly interest he took in the matter.

CLEMENT E. STRETTON.

Leicester, England.

Famous War Locomotive "General."

EDITOR:

Having had occasion recently to run down South, I was greatly interested in the rapid development of railroad equipment. It seems in almost every way to equal the North and East, especially in the matter of locomotives and rolling stock. By way of contrast it was very interesting to have the pleasure of seeing the famous war locomotive "General" of the Western and Atlantic railroad, now on permanent exhibition in the Union depot at Chattanooga, Tenn. To outward appearance the war worn veteran looks like new. In fact very few locomotives in the palmy days of burnished brass and gold gilding ever shone like the "General." It will be remembered that it was captured by some Union soldiers in April, 1862, and was recaptured after an exciting chase of nearly ninety miles by some Southern railroad men aided by Confederate soldiers. The "General" is certainly a very interesting relic and likely to be an enduring reminder of war times. It should be noted that the "General" was saved from the scrap heap by the officials of the Nashville, Chattanooga & St. Louis Railroad.

D. M. HARRIS.

Newark, N. J.

FAMOUS CIVIL WAR LOCOMOTIVE, "GENERAL."

Robert Quayle on "Character."

In addressing the General Foremen's Association, Mr. Robert Quayle, general superintendent of motive power of the Chicago & Northwestern Railway, said:

I have another note here. If I were asked by a young man—I see a lot of young men, but age is simply a matter of how old you are yourself. When I was a boy about 10 or 12 years of age, I looked at the fellow 25 and I thought he was awful old, and when I got up to 25 I looked at the fellow 40 and thought he was an old man, but now since I got up to about 90 and I look at the fellow 100 or 120 years, I do not think it means anything. He is only a young man. But if a young man were to come to me and ask me how to succeed, do you know what I would tell him was the first essential to success. I want you to listen to this. You might say a good technical education. I would not. That is a splendid thing. You might say a fine physique and good health. I have had that all my life, not such a fine physique as good health. My physique is all right of the kind, but it is a very small kind. That would be a good thing, and I might name a good many other things, but the greatest thing for us to cultivate is character. CHARACTER, and I want you to spell it with capital letters. Character simply goes out from you in every word that you speak and indicates the kind of man you are. It will be reflected today in the work that you do. It is reflected in your conversation: it is reflected in your home; it is reflected in the community in which you live—the kind of character you have—the kind of man you are, and don't we all like to be the best kind of man we can be?

We say sometimes: "What do we care about public opinion?" What would you do without it? You could not go to a bank here and open up an account unless they have confidence in you. Not me. Not you. If you come to my office and you know who I am and what I am and I say: "Yes, I will do that." If you know me to be right—not only me but anybody else—Brother Sinclair, if he makes a statement in his paper and it is over his name, you know it to be right and you know he is not catering to anybody, and you know, when I say to you: "Yes, I will do it," the old man said he would do it and that settled it. That ought to be as good as law and that ought to be your position and your attitude in life, in your home, and in the shop, on the street and wherever you are. And that character will bring confidence, and that confidence will get results and the results lead you and through it you become important, and that importance then is attached to your family, and your wife—she doesn't say anything but she looks wise and she says: "That is my husband," and she is proud of you. Do you want your wife to be proud of you. Be a better man than you are a general foreman. Have a better character than you have ability to do things, and when you do that, not only the community but everybody else will say you have done well. The men in charge will say like the Lord over all: "You have been faithful over few things, I will make you ruler over many. Come up higher."

Purchasing Agents.

A new organization known as the National Association of Purchasing Agents was formed in New York City last month. Over one hundred members, representing some of the largest industrial corporations, railroads, steamships, street railways, and electric companies in New York and vicinity, are already enrolled, and several hundred are proposed for membership.

Mr. H. T. Leeming, of the Thomas A. Edison Company, was elected temporary chairman, and Mr. E. B. Hendricks, secretary and treasurer. Temporary headquarters is at the Hotel McAlpin. The Association purposes forming branches in all parts of the country, and an active campaign is already being inaugurated with a view to the formation of the purchasing agents and buyers into a national body. All communications should be addressed to Mr. E. B. Hendricks, P. O. Box 1406, New York City.

The railroads of the United States use about 150,000,000 wooden ties each year, with a steady increasing demand.

4-8-2 Type of Locomotive for the Rock Island Lines

A fine example of the Mountain (4-8-2) type of locomotive has recently been introduced on the Rock Island Lines, and while the reports in regard to the performances of the two engines known by the road numbers of 998 and 999 are not yet completed, the universal opinion of those in authority in the mechanical department is that they possess advantages both in point of fuel economy and power superior to any other type of locomotive hitherto tested in the severe service incident to the steep grades and sharp curves on many portions of the Chicago, Rock Island and Pacific Railway.

The two locomotives were built by the American Locomotive Company at the works at Schenectady, N. Y., and embody all the latest improvements as may be largely observed in the accompanying illustration. This new class is the result of the long experience of the American Locomotive Company in the gradual improvement and consequent development of powerful locomotives adapted for the hardest kind of service, and it may be added that in the application of this experience to the special requirements of the service of the Rock Island Lines, the constructors were guided by the officials of the mechanical department, and to whose intelligent co-operation in the preparation of the special design the very marked success of these powerful locomotives is largely due.

The following are the general dimensions of these locomotives:

Track gauge, 4 ft. 8½ ins.; fuel, Bituminous coal.

Cylinder—Type, simple; diameter, 28 ins.; stroke, 28 ins.

Tractive Power—50,000 pounds.

Factor of Adhesion—4.48.

Wheel Base—Driving, 18 ft.; rigid, 18 ft.; total, 38 ft. 11 ins.; wheel base, total, engine and tender, 71 ft.

Weight—In working order, 333,000; on drivers, 224,000; on trailers, 51,500; on engine truck, 57,500; on engine and tender, 490,500 pounds.

Boiler—Type, wagon top; O. D. 1st ring, 78 ins.; boiler working pressure, 185 lbs.

Firebox—Type, wide length, 108 ins.; width, 84 ins.; firebox thickness of crown, ⅜ ins.; tube, ⅝ ins.; sides, ⅜ ins.; back, ⅜ ins.; firebox water space, front, 6 ins.; sides, 5 ins.; back, 5 ins; firebox depth (top of grates to center of lowest tube, 29½ ins.; crown staying radial.

Tubes—Material, cold drawn seamless steel No. 197, diameter 2¼ ins.; flues, material, cold drawn seamless steel No. 36, seamless, 5½ ins.; thickness, tubes 135 MM flues, .150 MM; tubes, length, 22 ft.; spacing, ⅞ in.

Heating Surface—Tubes and flues, 3,785 sq. ft.; firebox, 287 sq. ft.; arch tubes, 25 sq. ft.; total, 4,117 sq. ft. Superheating surface, 944 sq. ft. Grate area, 62.7 sq. ft.

Wheels—Driving diameter, outside tire, 69 ins.; center diameter, 62 ins. Material, main, cast steel; others, C-steel; engine truck, diameter, 33 ins.; kind, rolled steel; trailing truck, diameter, 42 ins.; kind, cast steel center; tender truck, diameter, 33 ins; kind, rolled steel.

Axles—Driving journals, main, 11½ ins. x 22 ins.; other, 11 ins. x 13 ins.; engine truck journals, 7 ins x 12 ins.; trailing truck journals, 9 ins. x 14 ins.; tender truck journals, 6 ins. x 11 in.

Boxes—Driving, main and others, C-steel.

Brake—Driver, Amer. W. U. -3; West. Elec. 6, truck; W. V. & B. C.; trailers, W. V. & B. C. L.; tender, West Elec. 6; air signal, West.; pump, 8½ CC reservoir, two 18½ x 102.

Engine Truck—Four-wheel, Woodard type. Trailing truck, radial outside journals, 6 3/16 ins., 6 5/16 ins.

Exhaust Pipe—Single, nozzles 6 7/16 ins.

Grate—Rocking Ry. Co.'s style.

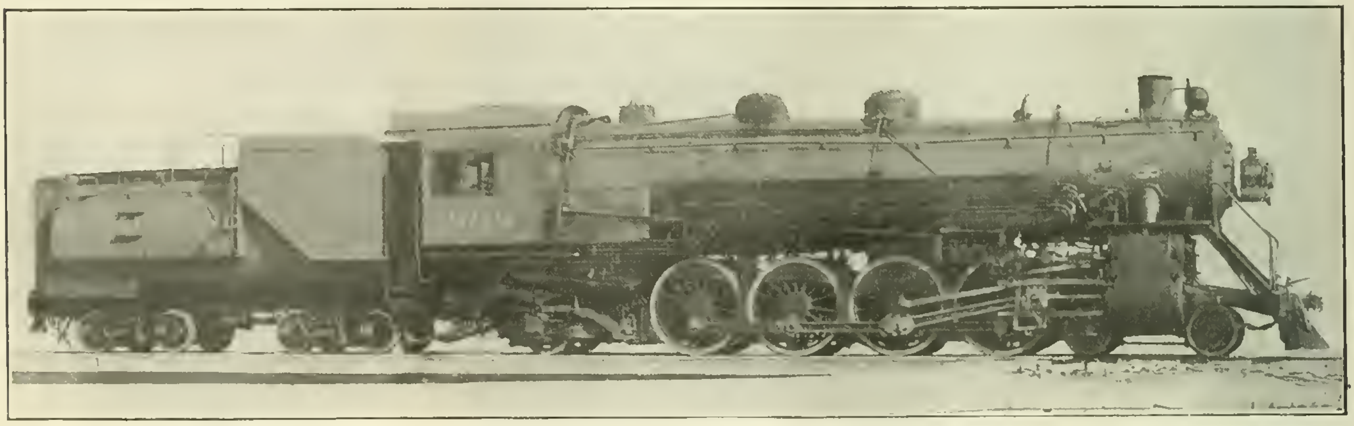
Piston Rod—Diameter 4½ ins.; piston packing, gun iron rings.

Smoke Stack—Diameter, 18 ins.; top above rail, 15 ft. 7⅜ ins.

Tender Frame—Vanderbilt type of steel angles.

Tank—Vanderbilt style, cylindrical; capacity, 8,500 gals.; fuel, 14 tons.

Valves—Type, 16 ins. piston; travel, 6½ ins.; steam lap, 1 1/16 ins.; extra clearance, 1/16 in.; setting, ⅛ in. lead.



MOUNTAIN 4-8-2 TYPE LOCOMOTIVE FOR THE ROCK ISLAND LINES.
W. J. Tollerton, Gen. Mech. Supt. American Locomotive Company, Builders.

American Museum of Safety.

Railroads covering nearly a billion locomotive miles are in the competition for the first award of the E. H. Harriman Memorial Medals, which will be made at the First International Exposition of Safety and Sanitation, to be held in New York City, December 11 to 20, under the auspices of the American Museum of Safety, 29 West Thirty-ninth street.

All of the awards will be made on this occasion, including the Harriman Memorial Medals, the Safety Exposition Medals, and the annual medals of the American Museum of Safety, consisting of the *Scientific American*, the Travelers, the Seaman and Rathenau medals.

An Early Compound Locomotive.

In 1875 there was put to work on the Worcester & Shrewsbury Railroad a small locomotive having two cylinders, one of them 5 inches the other 8 inches in diameter. It was the first compound locomotive operated on the American continent and worked remarkably well, using about three-quarters the amount of fuel burned by simple engine of the same capacity.

Catechism of Railroad Operation

NEW SERIES.

First Year's Examination.

(*Continued from page 392.*)

Q. 28.—What are the effects of too strong a draught?

A.—Too much air will be drawn up through the fire, reducing the temperature in firebox, and the gases which are very light will pass out through the flues before they have time to burn.

Q. 29.—What bad effects would follow carrying too heavy a fire?

A.—Air could not get through the fire in sufficient quantities to furnish the oxygen to burn the gases, and the best part of the fuels would be lost.

Q. 30.—What bad effects would follow carrying too light a fire?

A.—Too much air would enter the firebox and cool the gases below the igniting point and they would be wasted.

Q. 31.—If while the engine is standing the fire becomes very light and thin, what effect would starting a heavy train have on the fire?

A.—It would tear holes in the fire.

Q. 32.—What harm would result from putting more than three or four scoops of coal on the fire at one time, under working conditions, with bituminous? with anthracite?

A.—With bituminous coal it will start a bank which will turn into a clinker and cut out part of your grate surface; with anthracite coal it would cause holes to be torn in the fire.

Q. 33.—What are the advantages of utilizing the entire grate surface?

A.—You have more fuel burning and will produce more heat and steam.

Q. 34.—How can you prevent coal from being forced through the flues and out through the stack?

A.—By keeping the fire free from banks and clinker, of an even depth and sufficiently heavy to meet requirements.

Q. 35.—Is there a serious loss from this cause? If so, what conditions tend to increase it? what conditions will decrease it?

A.—Yes, having the fire too light, having holes in the fire, clinkers and banks in the fire or the exhaust too sharp will increase the waste. Having the fire of proper thickness, free from clinkers and banks and even all over with plenty of oxygen being supplied through the fire, will tend to decrease the waste.

Q. 36.—What causes a pull at the firebox door when the engine is working?

A.—By having the fire too heavy, badly clinkered or banks in it, or with the dampers to ash pans closed or draught openings shut off so there is not sufficient air entering through the fire, to fill the vacuum formed by the exhaust, atmospheric pressure on the firebox door causes the pull.

Q. 37.—What will cause the engine to tear holes in the fire?

A.—By having the fire lighter in spots than it should be, or by allowing clinkers and banks to form, compelling the air to come through the free spots with great force.

Q. 38.—What will cause dead spots in fire, with bituminous or anthracite coal?

A.—Dead spots are formed in a bituminous or anthracite coal fire by neglecting to fire evenly and supply fuel as it is burned, or by clinkers keeping the air from furnishing the oxygen to keep up the burning in that spot.

Q. 39.—Will improper firing cause banks and clinkers to form in the firebox? What are the bad results from this?

A.—Yes, clinkers and banks are formed by not firing evenly at all times, and the bad results from clinkers and banks are fuel wasted, grate surface not all being used, dead spots formed, low steam pressures, flues and firebox seams caused to leak.

Q. 40.—What is the cause of the drumming in the firebox when engine is shut off? How can you avoid it?

A.—Drumming in the firebox is caused by the oxygen and gases in the firebox mixing in proper proportions to explode. To stop it either admit more air by opening the firebox door, or reduce the supply of air by closing the dampers to ashpan openings.

Q. 41.—What are the effects, good or bad, of raking the fire when the engine is working?

A.—Bad, it will cause clinkers and holes to form in the fire.

Q. 42.—Describe the ashpan and say what its duties are?

A.—The ashpan is box like in shape, made of iron or steel, and is suspended under the grates. The duty of the ashpan is to catch ashes and cinders as well as live coals that fall through the grates and prevent setting fires; it also provides a means of controlling the flow of air through the fire.

Q. 43.—Why is it important that ashpan dampers and slides be kept closed while on the road, especially in dry, hot seasons?

A.—The dampers and slides should be kept closed to prevent live coals from falling out of ashpans and setting fires.

Q. 44.—Why are the damper and netting openings provided in ash pans?

A.—To furnish openings for the air to enter the ash pan under the fire, and the dampers provide a means for controlling the admission of air to the ash pan and in that manner control the draught on the fire.

Q. 45.—Why are grates made to shake?

A.—The grates are made to shake so that clinkers may be broken up and ashes shook through them into the ash pan.

Q. 46.—When should the grates be shaken? Why?

A.—The grates should be shaken when the engine is not working steam, because to shake the grates when engine is working will cause holes to form in fire.

Q. 47.—Does any loss occur from shaking the grates too frequently or too severely?

A.—Yes, the fire is made too thin and much good coal is shaken into ash pan.

Q. 48.—What would you do in case of a disconnected grate?

A.—I would try to connect it up, if impossible to do that would straighten it up so that the fingers would not be burned off.

Q. 49.—What would you do in case of a broken grate?

A.—I would cover the opening with pieces of iron or stone to keep the coal from dropping into ash pan, and keep the cold air from entering firebox.

Q. 50.—If clinkers form on the grates, what will be the effect on the fire, and how would you avoid it?

A.—Clinkers on grates shut off heating surface of the fire, and cause dead spots, and will cause the exhaust to tear holes in the fire. I would avoid this by keeping the fire clean and firing evenly all the time.

Q. 51.—What will be the effect of allowing the ash pan to become filled with ashes and clinkers?

A.—With the ash pan filled, the draught is shut off and air cannot enter in sufficient quantities through the grates to furnish the oxygen for burning, and the grates are liable to burn.

Q. 52.—Do you consider it beneficial or otherwise to admit air above the surface of the fire?

A.—No, it is not good practice to admit air above the fire, because it cools the gases below the igniting temperature and much of the best heat producing part of

the fuel is wasted; it also tends to cause the flues to leak.

Q. 53.—What effect does opening the door have on the fire?

A.—It deadens the fire, because the oxygen is not coming up through the fuel nor getting in contact with it.

Q. 54.—Is it good practice to leave the fire box door open longer than is absolutely necessary while the engine is working? Why?

A.—No, because the forced draught will cause large quantities of cold air to be drawn through the flues, contracting them and causing them to leak.

Q. 55.—What is black smoke and is it combustible?

A.—Black smoke is small particles of carbon going away unconsumed. It is combustible and will produce great heat if it has the oxygen present to combine with and the proper temperature for combination at the time it is given off as free carbon from the fire.

Q. 56.—Why does the black smoke clear up so quickly when firebox door is opened?

A.—Because the oxygen for its burning is admitted in sufficient quantity to combine with the gases and consume them, resulting in a colorless gas.

Q. 57.—What effect has the stoppage of a number of the boiler flues?

A.—It reduces the heating surface and causes the draught on the fire to be unequally distributed.

Q. 58.—What harm may follow if a bank be allowed to form and remain against the flue sheet?

A.—The lower flues are cooled off and will be weakened and will begin to leak, besides a clinker will form and cold air will pass up between it and the flue sheet.

Q. 59.—Has improper firing a tendency to cause the flues to leak? How?

A.—Yes, by causing the temperature in firebox to vary, the continual expansion and contraction of the sheets and flues weakens them and makes them leak.

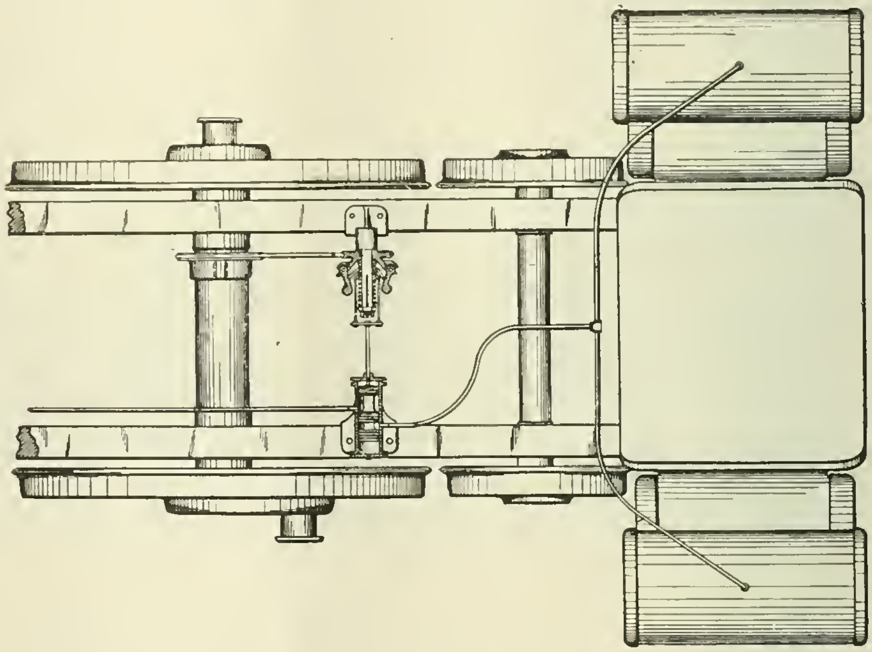
Drifting-Valve Mechanism for Locomotive Engines.

The accompanying illustration shows a plan or top view of a portion of a locomotive frame and cylinders, to which is attached a valve mechanism for controlling the admission of a small quantity of steam to the valve chests of a locomotive engine when drifting, or running with the throttle closed. The admission of a small jet of steam from this source being for the purpose of maintaining sufficient lubrication and preventing the formation of a vacuum in the cylinders, the object of the device being to provide mechanism of simple construction to automatically and positively close such admission when the locomotive comes to a stop, or when the speed is reduced below a certain low rate, and to automatically open and permit a limited quantity of steam to flow to the steam chests and cylinders when the locomotive is running at or above the predetermined minimum rate of speed.

It will be observed in the drawing that there are two pipes leading from the main valve chests which unite at a central union immediately behind the saddle. A single pipe from the union leads to an enclosed casing in which a valve of the piston type is enclosed. From the rear side of this casing or valve chest a small pipe leads to some convenient part of the boiler, so that steam is admitted to the small valve chest when the boiler is under pressure of steam. The valve chest is securely attached to the frame and the valve spindle runs through a stuffing box to another casing attached to the frame at the other side of the engine, in which a coiled spring is enclosed. A centrifugal governor, such as is shown in the drawing, and is securely mounted on a fixed shaft, bolted by means of a bracket. Rotatably mounted upon the shaft is a grooved pulley having rigid arms to which are pivoted the centrifugal weights, coupled by links with a rotatable collar or sleeve on the shaft.

The motion of the pulley moving the centrifugal weights is derived from another pulley attached to one of the driving axles of the locomotive, and between the two pulleys there is a suitable driving connection, such as a belt which may be formed of coiled wire, so that when the locomotive is running with the throttle open, the governor is being rotated at such speed that the weights are thrown outward by the centrifugal force, thereby moving collars longitudinally upon the shaft, compressing the spring, and actuating the balanced piston valve to its open position thereby admitting a limited quantity of steam through the pipes to the engine valve chest and cylinders.

It will thus be observed that there is a constant flow of steam through the pipes at all times while the engine is running, or at least until the speed has reached some particularly low point according to the adjustment of the coiled spring. The admission of this very small additional quantity of steam to the engine cylinders at the time that the throttle is open, is, of course, immaterial, and has no appreciable effect, as the amount of steam thus admitted is inconsequential compared to that admitted through the throttle valve.



DRIFTING VALVE MECHANISM FOR LOCOMOTIVE ENGINES.

As is well known when the throttle is closed and the locomotive continues running, or "drifting" as it is called, the movement of the pistons in the engine cylinders tends to create a vacuum therein, and while relief valves and other devices have been used in overcoming the trouble, it is generally admitted that there is a growing need of some more effective device in overcoming the tendency of creating a vacuum and also as well as to prevent the carbonization of the oil and thereby maintain an efficient lubrication in the cylinder.

The device is the invention of Mr. W. H. Foster, New York, and we understand that a patent has been secured on the mechanism.

Sellers' Extra High Power Radial Drill

The 60-inch extra high power radial drill here illustrated is one of the latest products of the William Sellers & Company, Philadelphia, works. The illustration shows the work table and the usual arrangement of the motor controlling apparatus. The machine is of unusually heavy construction, intended for the most severe service.

The drilling head is so designed as to bring the spindle as close to the face of the arm as possible, the twisting tendency thus being reduced to a minimum. The spindle is of steel 4 inches diameter throughout and 5 feet long with a stroke of 18 inches.

The spindle does not revolve in bearings, but is carried by a long rotating sleeve, in which it slides for vertical adjustment. This arrangement relieves the spindle of any bending effect from the driving gear and from any wear due to rotation. It also gives it the support of the long sleeve which revolves in bronze bushed bearings.

The spindle is counterweighted and, in place of the usual rack feed, they employ a quick pitch revolving screw having a fixed nut at the top of the spindle and a ball step for taking thrust in both directions. The spindle is quickly adjustable by hand.

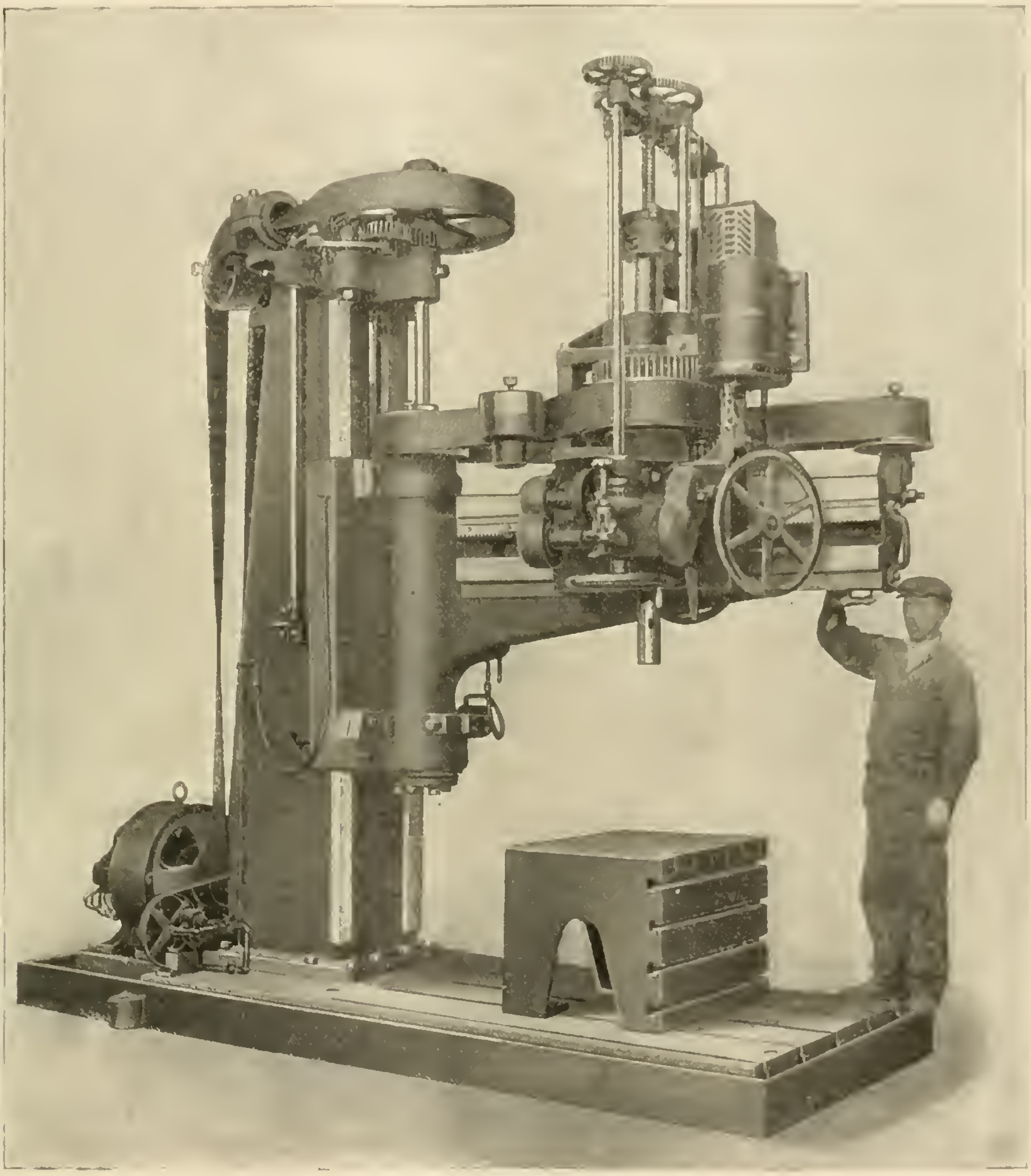
For all moderate-sized drills the drive is direct by a heavy belt absolutely without gearing, but a back gear is provided for use with large drills at slower speeds. The usual spindle speeds are from 70 to 300 r. p. m. The feed motion is positive and has six steps in two series. All gears are steel except the worm gear in the feed train, which is bronze. All gearing is carefully enclosed with proper guards.

The drilling head is moved on the arm through a spiral pinion and steel rack, the hand wheel being directly on the head. A lock is provided for securing the head against accidental motion.

The radial arm is generously proportioned, of box construction, to withstand the eccentric load of the drill pressure. It is carried upon the saddle by roller bearings and a ball bearing step. A clamp is provided for securing the arm against rotation and if desired this may be arranged to work by air pressure without the attendant leaving the working position.

The saddle is unusually long and has a bearing 20½ inches wide on the post or upright. The upright also is broader and deeper than is customary in machines of this character.

The bed plate, 8 to 10 inches deep by



SELLERS' 60-INCH HIGH POWER RADIAL DRILL.

4 feet 6 inches in width, is extended back of the upright to carry the motor. It has a water trough around its edge draining into tanks at the rear of the upright and a power pump and pipe system are provided for circulating the drilling compound.

Special care has been given to grouping the controller handle and other operating parts within easy reach of the attendant.

These machines are usually driven by a 20 h. p. variable speed motor as illustrated, but may be driven by a belt if desired, in which case a 4-step cone pulley for a 5-inch belt occupies the position of the motor.

Questions Answered

LOCOMOTIVE WHEEL TROUBLE.

Editor:

We are having some trouble here with three engines that have had general repairs in the main shop recently. They are freight engines with cylinders 24 inches in diameter, and 30 inch stroke. The diameter of the driving wheel centers is 50 inches. The tires at the present time are 1¾ inches in thicknes. The boiler pressure is 200 pounds. Of the four drivers the first, third and fourth drivers are flanged. The second or main driver are what is known as ball tires. These engines strike the frog points unusually hard when running at about 20 miles per hour, and apparently it is the back pair of wheels that strikes the hardest. The locomotive feels as if it had left the track for a short distance before it runs smooth again. The shock is frequently so great that the engineer and fireman are tossed against the side of the cab.

In the matter of investigating the trouble the mechanics in the shop state that there are no mechanical defects, and the track men are equally positive that the track is everywhere in excellent condition. It would be gratifying to many of the railway men here to have your, or some of your able correspondents give us their opinion in regard to what might be the cause of the trouble. We are at our wits' ends.

Hard Grease.

Norfolk & Western R. R., Crewe, Va.

Without having an opportunity of examining the engines referred to, and in the absence of any data as to the length of rigid wheel base, it is largely a matter of conjecture as to the cause of the trouble. If the mechanical department is correct in their allowance of lateral motion, it would be interesting to try, if possible, an ordinary pair of flanged wheels on the main drivers as well as the others, as an engine so equipped must necessarily strike with great force on the flanges of the rear wheels. We invite our readers to give us the benefit of their experiences, as the subject is an interesting one.—Ed.

SILVER PLATING OR NICKEL PLATING.

D. W. F., San Luis Obispo, Cal., writes: Observing silver-plating or nickel-plating by electric appliances it occurred to me that there were simpler and cheaper methods of plating, but I cannot now recall the process. Doubtless you many be able to shed some light on the subject. What is a ready and inexpensive method of plating small pieces of iron or other metals?—A. In nickel-plating iron, a thin coating of copper is first produced on it by rubbing on a solution of 20 parts sulphate of copper, 5 parts sulphuric acid and 100 parts of water. After the copper plate has been formed rub over it, with a rag, a solution of 3 parts tin, 6 parts nickel and 1 part iron in 100 parts of hydrochloric acid and 3 parts of sulphuric acid. If finally the object is rubbed with a rag that has been dipped in finely pulverized zinc, a nickel deposit will be formed on the copper. The thickness of the deposit of nickel can be increased by repeating the two last operations.

According to a recent patent, a silver coating can be produced by dissolving freshly precipitated chloride of silver in a solution of hyposulphite of soda, 1.1 parts to 10 parts of water, and adding to this solution 180 parts spirits of sal ammoniac and then stirring in 800 parts of finely washed chalk. This mixture is applied and rubbed until it dries on the object being silvered, and the result is a brilliant deposit of pure silver.

The following formula for "nickel-plating" brass and copper parts has proved very satisfactory. In using this method, the first step is to see that the parts to be plated are quite clean and free from grease. The work is then dipped in a saturated solution of bi-chloride of mercury or else a paste is applied by rubbing. This treatment causes a film of mercury to be deposited on the work, and when this result has been obtained the pieces are dried in saw-dust and then lacquered in the usual way.

If a paste is found more convenient to use than the solution, it may be prepared by adding water to the powdered bi-chloride of mercury to obtain the required consistency. It is essential that the parts be lacquered after they have been plated in this way; otherwise the mercury will wear off in a short time.

NEW MIKADOS FOR THE READING.

G. T., Millville, N. J., writes.—Can you tell me, in your magazine, if the new Mikado engines, which Baldwin Works are now building, are of the "camel-back" type, or not? The engines are for the Philadelphia & Reading; and would it be possible to publish a view of these engines when they are completed? Are the "camel-backs" being discarded? A.—The new Mikado type locomotives now being built for the Philadelphia & Reading Railway will have the cab at the rear instead of over the middle of the boiler. The latest engines built by the Baldwin Works for the Lehigh Valley Railroad are similarly constructed. This arrangement is used because it is not necessary to separate the engineer and fireman as is the case on locomotives of the "camel-back" type. It will be some time before detailed information can be secured in regard to the Philadelphia & Reading locomotives. We will endeavor to publish full information as soon as it is available.

VARIATIONS IN LEAD IN THE WALSCHAERTS VALVE GEAR.

J. B. Souris, Man., Canada, writes.—In your answer last month on "Variations in Lead in the Walschaerts Valve Gear," your explanation does not seem to me to quite cover the point raised by the question. I am not an expert but am looking for light all the time. Now if the valves are set with ⅛-in. lead in forward motion, and ⅛-in. negative lead in backward motion, would "hooking-up" from the forward corner not have the effect of decreasing the lead until there would be no lead either way when "hooked-up" to the center, and still keep decreasing the further back the lever was placed? It is hardly to be expected that such an adjustment would be practical, but in such a case, would not the moving of the reverse lever have the effect stated? A.—No. While it is an easy matter purposely distorting the Walschaerts valve gear, it will be found that one of its qualities is that of retaining the same amount of lead with different positions of the reverse lever. Complex experiments have been made with a view to slightly increase the lead in "hooking-up" as is the case in the Stephenson or shifting link. The results have invariably shown that a gain of lead in the forward motion has the effect of decreasing the amount of lead in the backward motion, and further that no kind of distortion improves the action of the valve gear, but the best results are found when all of the parts are correctly designed and properly adjusted. Very complete descriptive details with illustrations are found in Wood's "Walschaerts Valve Gear," price $1.50, and Kennedy's "Valve Setter's Guide," price 50 cents.

SUPERHEATER LUBRICATION.

A. B. S., Boone, Ia., asks.—Is lubrication destroyed on superheater engines, with or without relief valves on steam chests, at slow speed, and if so in what distance will it be destroyed? A.—Lubrication is not destroyed on superheater engines unless the heat is excessive and the supply

of oil very limited. In common practice 2 pints should serve for 100 miles, presuming that the oil is of best quality. Without superheater appliance a lower grade of oil may be used. The use of relief valves has been dispensed with on some of the leading railroads. In high speed passenger service the relief valves broke occasionally and instead of being a relief were looked upon as a hindance. Other roads retain their use. It may be added that the oil furnished by the Galena Oil Company retains its lubricating qualities up to 249 degrees, Fahrenheit.

BLOW AT UNIVERSAL VALVE.

H. L., Washington, D. C., asks: What causes a blow of air from the exhaust port of the U. C. triple valve when cars are being charged, and which stops after an application of the brake?—A. A leak from the release slide valve seat which indicates that someone has used the emergency reservoir drain cock to bleed off the brake thereby permitting brake cylinder pressure to unseat the release slide valve while escaping from the cylinder. During the application the movement of the release piston reseats the slide valve and the blow ceases, provided that no foreign matter lodges on the seat or ruins it. To bleed off the brake, open the bleed cock in the auxiliary reservoir and close it as the brake starts to release. Under ordinary circumstances in yard shifting a change of pressures may leave one of the valves in service lap position similarly with triple valve and as the emergency and service reservoirs are cut off with auxiliary and brake pipe pressure effective on the equalizing piston obviously the auxiliary reservoir is the one to bleed to secure a prompt release; however, in cutting out the brake you would close the brake pipe cut-out-cock and bleed all four reservoirs.

BREAK-IN-TWO OF TRAIN.

J. I. B., Richmond, Ind., writes: What action of the air brake is there that will break a train in more than two places, or how does the slack run in order to do such damage? A.—Undesired quick action under certain conditions might part a train, but generally it is due to some other cause than brake action alone. For an example, we have frequently observed trains broken in three portions by a failure to allow ample time to elapse between the opening of the engine throttle and the movement of the brake valve to release position, or by trying to start the train before the rear brakes have had time to release.

Under such conditions the head brakes are released and the rear ones are practically anchored or if in motion are coming to rest, then if the large locomotive accelerates the forward portion the rear end must almost immediately be accelerated with the forward cars or the couplings must be strong enough to hold the head end and instantly bring the rate of speed down to that of the rear cars. As it is physically impossible for the train intact to run in different directions at the same time beyond the limits of the slack, it naturally follows that, when the two ends start in different directions with any considerable speed, the couplings must part. As to breaking in more than two parts, if the rear end practically comes to a stop with the brakes applied while the forward portion is started into motion, the break will likely occur at the weakest coupling near the portion with the brakes applied, then as the train parts quick action is initiated at the rear end of the forward portion, instantly setting brakes and tending to stop only the cars on which quick action occurs; the locomotive again runs away from a part of the train, which may happen twice after the first break.

EMERGENCY INDICATOR.

J. M. Ft. Wayne, Ind., writes: Why is it that the emergency indicator sometimes fails to register quick action when it takes place? On a six-car train two indicators between second and third cars and between fourth and fifth cars pointed to the rear, and, when indicator was placed between fifth and sixth cars, quick action took place but indicator did not register. A.—This does not mean that there is anything wrong with the indicator; it indicates that, while quick action took place on the fifth car, the brake pipe volume on the sixth car was not sufficient to move the indicator. This could be overcome by a closer fit of the indicator diaphragm, but it would not be advisable, as it would tend to interfere with its present satisfactory operation; you can remember that, when the action you write of occurs, quick action was initiated on the fifth or next to last car; if, however, the sixth or last car works quick action, the indicator will register it.

SLIDE VALVE RESISTANCE.

A. B., Youngstown, Ohio, writes: Is a triple slide valve harder to move under air pressure when it is oiled than when it is dry? I have heard the statement made and cannot see how any lubricant could make it harder to move. A.—The valve will be easier to move when perfectly dry. The generally accepted laws of frictional resistance do not always hold good in air brake practice; as a general proposition friction between two metal surfaces in contact increases when dry or with the application of some adhesive substance and decreases with the application of any lubricant, and also holds good on the triple slide valve under pressure if certain kinds of lubricant are used, dry graphite as an example. However, if oil is used in a sufficient quantity to leave a film around the slide valve edges to act as a packing, after being at rest for a few minutes the valve will offer more resistance to movement than when perfectly dry, or will require about twice as much or more force to dislodge it. When dry, air pressure can get under the slide valve and tend to balance the pressure, thus making it easier to move than when all air pressure is excluded.

Headlight Wicks.

A young engineer was heard to remark: "I ran an engine two years before I knew how to turn up the headlight." Had this remark been ventured in any other than a railroad crowd, the speaker would have been considered a very poor specimen of an engineer, but the brothers knew that he was a first-class man and permitted him to go on.

"You see a wick is made up of several wraps of Canton flannel, as it has to slide over one tube and inside of another. Now if one or both get a little rough, the wick sticks in being forced up and 'wrinkles.' When the engine gets pounding over the road the wick works up and the headlight smokes without any apparent cause. Now I just turn mine up too high, then lower it to where I want it which straightens the cloth out and it keeps giving out a smokeless light." All the group acknowledged that the young engineer understood all about headlights.

One Side of the Smoke Nuisance.

In a recently published statement, Mr. D. F. Crawford, of the Pennsylvania Lines, says: Of the smoke produced in any locality where bituminous coal is burned for manufacturing power and domestic purposes, it will be found that locomotives contribute from 15 to 20 per cent. of the smoke, with perhaps a higher percentage in localities where comparatively few industries are located and, of course, a considerably greater proportion than fuel other than bituminous coal is used for domestic purposes.

That expression from Mr. Crawford, an expert on smoke raising may be accepted as reliable; yet in some small towns that are smothered from the smoke pouring out of factory chimneys the people attribute the whole of the smoke nuisance to emanate from locomotives.

A German scientist has discovered a new species of nervous disease caused to people who have been in railway accidents. They might come out of the wreck without sustaining injury, but when they become mixed up in suits for damages very serious nervous disorders result. Such disorders were sufficiently serious to impair the victims' earning power which meant the claim for increased damages.

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Difficulty of Introducing Locomotive Appliances.

A great many of the appliances which contribute to the safety, comfort, efficiency and convenience of the modern locomotive were applied as quickly as the necessity for them arose that their introduction is scarcely mentioned in the meagre historical notes that have been published. It is within the memory of men still living that all the cab appliances of a locomotive were the steam throttle lever and the reverse lever. The writer remembers hearing an old engineer talk strongly against the steam gauge as being a useless encumbrance in the cab; and later on objections were raised to the three-way cock of the Westinghouse air brake as making too many appliances for an engineer to remembe

A man becomes accustomed to go through motions automatically in the handling of an engine, motions that are as accurate in the dark as in daylight, which causes the enginemen to object to changes and accounts for the conservative character of these men. All through the improvements effected upon the locomotive we find the enginemen in opposition. This was peculiarly the case with the introduction of the injector, which is a much superior boiler feed than the troublesome pump, and yet it had to fight its way slowly on most of the roads where it is now in universal use. The same may be said of the sight-feed lubrication and of all other cab appliances now considered standard conveniences.

Making Hard Water Harmless.

Modern methods of softening hard water or of removing the scale-forming impurities have done much to render time-infected feed water harmless, but for many years railway companies paid a heavy tax in boiler repairs for scale-covered heating surfaces. The greater portion of this expense would have been spared had the locating engineers exercised proper care in the locating of water stations. The pioneer practice was to locate water stations at prearranged distances, no attention having been paid to the nature of the water obtained. Deep wells were often dug through limestone rock in locations where creeks carrying fairly soft surface water could have been made to supply the water required for locomotive use. Taken as a whole, hard water is more easily secured than water free from scale-making impurities.

The writer was once required to investigate the cause of difficulty with water at a certain terminal where the fireboxes of the switching engines lasted only about two years. On examination it was found that water was supplied from a well 200 feet deep, excavated through limestone rocks on the bank of the Mississippi river, and contained 83 grains to the gallon of sulphate of lime, the worst scale-forming ingredient encountered. When the supply pipe was pulled out of the well and pushed into the river, which has seldom more than 9 grains of impurity to the gallon, the trouble with the switching and other engines ceased.

Throughout a very wide area of territory on the North American continent, limestone, or various forms of calcareous rocks, constitute the upper rock stratum immediately underlying the sub-soil of the great agricultural and grazing regions. During the stupendous operations of nature in building up this continent, the rocks have been subjected to vast disintegrating agencies. They have been torn and eroded by huge masses of ice; they have been scorched by rays of the unshadowed sun, fractured by the congealing power resulting from deep-reaching frost; melted by water—that most universal solvent in the world; then scattered far and wide by ice and flood. This process has been so complete that in the whole wide-reaching limestone territory all the earth seems charged with lime.

Limestones are very sparingly soluble in pure water; but the water that falls from the clouds is not pure, but contains a charge of carbonic acid that acts chemically upon the lime, forming salts, which the water readily dissolves. Owing to this circumstance, there are few streams, and fewer wells, in the calcareous districts that are not contaminated with lime. The water that passes into streams, generally runs over surfaces that have been washed partly free from lime; and in consequence of this, creeks and rivers are not so badly tainted with lime salts as the water in wells that stands saturating on the rocks. The appearance or taste of water gives no indication of the quantity of lime or other solids held in solution; for the ice-cold mill, or sparkling spring, that supplies water so pleasant to drink, may yield so much lime-salts that the water would be ruinous to sheets and flues when used as boiler feed water.

It has been principally to the want of care in the locating of water stations that numerous tanks are today drawing their supply from lime-charged wells in regions where surface water could be easily obtained. Railway companies are particularly conservative about making changes that entail expenditure of money; and existing evils in the water supply arrangements are often continued because some expense would be entailed in making them; although no kind of outlay would bring a more ample return in economy.

The subject of feed water connected with boiler troubles has been frequently investigated and discussed by the Railway Master Mechanics' Association. At first the admission was made that "impure water was the bane of good boilers," and they started in hopefully to devise the necessary remedy. Next we read that "Different waters vary greatly in the component parts of the impurities they contain, and each requires separate study and treatment." The belief was expressed that the engineering and mechanical skill of railway men was equal to the solution of the problem of making bad water harmless. Experience demonstrated that purifying bad water was about as hopeless a task as reforming a bad man.

Nowadays there are very few amateurs, connected with railways, working on water purification. Selection of

water has been extensively followed and where good soft water cannot be secured, the softening process is turned over to parties whose acquaintance with chemistry and water analysis makes them reliable experts.

Ancient Fear of Monopoly by Railroads.

We are hearing a great deal today about railways being heartless monopolies, but the story or charge is older than any railroad in use. Before the wise men who constituted the Legislature of Pennsylvania would grant a charter for what is now part of the Pennsylvania Railroad they spent years of wrangling because some of them thought that a canal would be less liable than a railroad to fall into the hands of monopolists. Then when a railroad was agreed upon they wanted every farmer and horse owner to have equal freedom in operating it.

There was much controversy among the legislators about the rules to be framed for the operating of the railroad. Mr. W. B. Wilson, in his history of the Pennsylvania Railroad, speaking of the construction of this, one among the first railroads ever built in America, says: "At the period when railroads were introduced into this country the plans for operating them entered largely into the discussions as to their superiority and usefulness. The weight of popular opinion was in favor of the rules governing turnpike roads and adverse to centering the control of motive power on them either in the agents of the Commonwealth, individuals, firms, or corporations. Monopoly was the bugbear in the dreams of the people, while the greatest good to the country was expected to follow, giving to each and every individual citizen the largest liberty to roam as a carrier over the railroad at such times and in such a way as would suit his own convenience. It required actual performance to educate the people and demonstrate the fact that good results could only be attained by intelligent administration and executive control of railroads being centered in a proper and absolute authority."

Large Steam Ports.

One question of importance is seldom or never asked concerning the economical operation of the large locomotives coming into use, that is, how much waste of steam results from the inordinately large clearance spaces due to very large steam ports.

There appears to be great confusion of ideas among our master mechanics concerning the effect of large clearance spaces and of different sized steam ports. Quite a number of years ago there was considerable agitation in favor of shorter steam ports. In talking with a most intelligent master mechanic lately on this subject, he insisted that there was no economy in using short steam ports, for he had demonstrated this to his own satisfaction about the time the short port agitation was at its height. His method of demonstrating the thing was that he put pieces of metal into the steam ports to shorten them up to smaller dimensions. He watched the effect of this very carefully, and was unable to tell any difference in the coal consumption of the engines, consequently he reasoned that there could be no saving from having shorter ports. He ignored the important point, however, that by shortening up his ports he did not materially lessen the clearance spaces. A test of that kind demonstrated absolutely nothing. The only proper test to find out the effect of long and short ports would be to make an engine the same in every respect to others of a class, but make the cylinders with small ports and admission passages. It is generally acknowledged that there is no difficulty in getting the steam into a cylinder fast enough through contracted openings—the great difficulty is in getting it out at high piston speeds. If it is considered desirable to make the exhaust port longer, so that the steam could escape freely, there would be no difficulty in leaving it of ample length, and making the steam ports short, but it seems needless to make an exhaust port with 45 sq. ins. of area to pass out steam that goes through a nozzle with 8 or 9 sq. ins. of opening. American locomotives of a given size of driving wheel can force a train into high speed much more rapidly than foreign engines, and their capacity for fast running is much greater, but the owners may be paying too high a price for these characteristics.

The Traveling Engineers' Association are calling for suggestions concerning subjects to be investigated. We commend "piston clearances" to their attention.

Value of Innovation.

Lord Bacon was a very wise man and certain literary men have been claiming that he was the author of Shakespeare's plays which is absurd. Bacon's wisdom tended towards practical lines and his writings stimulated industrial progress. He said that "in order that the industry of others may be purchased and their courage aroused and influenced, the introduction of great inventions holds the first place among human actions. It was considered so in former ages, for to the authors of inventions they awarded divine honors, but only heroic honors to those who did good service to the state. And certainly if any one rightly compares the two, he will find that this judgment of antiquity was just; for the benefits of inventions may extend to the whole race of men, but civic or military achievements benefit only particular countries or localities. The latter kind of benefit last only a few years, a useful invention lasts forever."

Learning an Engineer's Duties.

When a sensible man, beginning to perform the duties of a fireman, has mastered his work sufficiently to maintain a steady pressure of steam, he soon begins to find time for watching the operations of the engineer. He notes how the boiler is fed, and upon his knowledge of the engineer's practice in this respect much of his firing is regulated. The different methods of using the steam by engineers so that trains can be taken over the road with the least expenditure of coal, are engraved upon the memory of the observant fireman. Many of the acquirements which commend a good fireman for promotion are learned by imperceptible degrees. Among these is the knowledge of speed, which enables a man to tell how fast a train is running on all kinds of track and under all conditions of weather. There would be no use in one strange to train service going out for a few runs to learn speed. He might learn all other requisites of engine running before he was able to judge within ten miles of how fast the train was going under adverse circumstances. The same thing may be said of the sounds which indicate how an engine is working.

It requires an experienced ear to detect the false note, which indicates that something is wrong with motion or exhaust. Amidst the mingled sounds produced by a locomotive and train hammering over a steel track, the novice hears nothing but a medley of confused noises, strange and meaningless as are the harmonies of an opera to an untutored savage. But the trained ear of an experienced engineer can distinguish a strange sound amidst all the tumult of thundering exhaust, screeching steam, and clashing steel, as readily as an accomplished musician can detect a false note in a many-voiced chorus. Upon this ability to detect growing defects which pave the way to disaster, depends much of an engineer's likelihood of success in his calling. This species of skill is not obtained by a few weeks of industry. It is the gradual accumulation of months and years of patient labor.

We glean from our "experience" note-book a case which illustrates the foregoing ideas. A machine shop foreman, a man of mature experience in building and repairing locomotives,

took out an engine on a trial trip. A side rod pin began to run hot, and although the man was leaning out of the side window, he did not observe that anything was wrong until a drop of babbitt metal struck him in the eye. An experienced engineer watching the rods would have detected the condition of the engine before babbitt was thrown.

A difficult thing for an inexperienced engineer to control in running an engine at night when the conditions of adhesion are bad is the slipping of the driving wheels. Slipping is a simple matter enough to those who feel it in the vibrations of the engine; but the novice has not this sensitiveness to slipping vibration developed, and he must depend upon his eyesight or his hearing to detect it. On a dark, stormy night, the eye is useless as a means of judging the regularity of the revolving wheels, for the howling wind or the rain rattling on the roof of the cab drowns the sound of the exhaust. Under circumstances of that character, a locomotive might jerk the pins off before the empirical engineer discovers that the wheels were slipping. Every man to his trade, say we.

Traveling Engineers' Committees.

The Traveling Engineers' Association has been celebrated among railway associations for practical work energetically performed, and from present indications they are preparing for a particularly useful convention in 1914. We have received from Secretary Thompson no less than five circulars of investigation with the names of the committees appointed to perform the work. On the work done by the committees of investigation the value and success of the convention depends in no small measure; so we can look forward to valuable reports and discussions at next meeting.

Advantages to be derived from the use of mechanical stokers is becoming a time worn subject, but it relates to decidedly progressive practice and the committee appointed to report upon it of which Mr. J. H. Desalis is chairman, will no doubt give needed information to railroad officials. The points to be reported upon are: Increased efficiency of the locomotive; to increase the possibility of securing a higher type of candidates for the position of fireman; the utilization of cheaper grades of fuel. There are now a large number of locomotives fired by mechanical stokers, so there will be no difficulty in securing the required information. The information floating about on this subject is, that the mechanical stoker enables locomotives to haul heavier trains than those fired by hand, and that the officials responsible for train movement are displaying warm interest in mechanical stokers. Mr. Desalis will be aided by seven members: Messrs. J. B. Bowen, O. B. Capps, J. B. Burgess, S. V. Sproud, O. C. Whitcomb, H. F. Heison, and A. L. Lopshire.

A novel subject for investigation that the Traveling Engineers' Association are working on is: Advantages derived from the use of "Speed Recorders" and the influence of same on operating expenses. Mr. Frederick Kerby who represents that inquiry has sent out fourteen questions to be answered in relation to the use, maintenance, and repair of speed recorders. We are afraid that the facts secured will not be voluminous. The use of speed indicators and speed recorders is general in some foreign countries, but they have never been popular on the American continent. In fact, many locomotive engineers have manifested so much pride in their knowledge of speed that they considered a speed indicator a reflection upon their engineering skill.

Mr. George H. Wood has been appointed chairman of a committee selected to investigate "The Care of Locomotive Brake Equipment on Line of Road and at Terminals; also method of locating and reporting defects." The committee's circular of inquiry contains nine questions to be answered, the aim being to find out how far enginemen are held responsible for the condition of air brake equipment, and what care is exercised to keep the brake equipment in proper working order. There has been such a tendency to employ specialists in caring for, maintaining, and testing brakes, that enginemen on some railroads have come to consider that no part of their duties, with the result that knowledge of air brake mechanism has deteriorated. The fact that knowledge is power should not be ignored in this important line of an engineer's duties, and railway companies and the traveling public will be benefited if a report on this subject is prepared that will excite increased interest in air brake equipment. Mr. Wood has Messrs. B. Haynes, R. E. Anderson, W. V. Turner, and Edw. Bales as his associates on the committee.

The very important business of selecting subjects for discussion at the 1915 meeting is in the care of a committee, of which Mr. Robert Collett is chairman, with associates, Messrs. D. Meadows, W. R. Davis, J. E. Inghing, and Fred McArdle. The work of this committee is highly valuable, for upon the selections made depends the success of a convention and incidentally the value of the organization throughout a year of its existence.

The progress of any technical organization demand changes of the by-laws to keep up with the times, for no constitution or rules can be framed in the beginning that will guide the association to all eternity; so the Executive Committee of the Traveling Engineers' Association has appointed a committee to revise the by-laws and report at next meeting. The chairman of the committee is Mr. W. Wakins, who is assisted by Messrs. W. F. Johnston, James Maxwell, I. H. Bowen, and W. H. Joslyn. The Traveling Engineers' Association does not need much stimulating to display business activity, but if the committee on by-laws can provide new rules that will make zeal and industry general among the members their labors will be rewarded.

And now a few words will be in season concerning the duties of members at large toward the Committees of Investigation. The chairmen of these committees are really collectors of information that ought to be sent in by the members. Our belief is that the members of the Traveling Engineers' Association perform their duty in this respect more efficiently than the rank and file of any other association. But there are exceptions to this rule and we urge the members who habitually put off the duty of replying to circulars to take a thought and mend. Procrastination is the thief of time and is likely to bar your way toward the position of president of some railroad.

$6,000,000 More Pay for Eastern Railroad Men.

The Board of Arbitration considering the claims of the conductors and trainmen of the Eastern Railways for increase of pay, has granted an increase aggregating $6,000,000, being one-third of the sum demanded.

A series of comments were made respecting the award, one of which reads: At the present time a ton of freight is moved in the Eastern territory more than three miles for the value of a two-cent postage stamp. This is the cheapest railroad service to the shipper to be found on the face of the globe. In the face of such a fact, it would be unjust to say that railroad employees must continue to be satisfied only with what can be paid them from freight rates as low as this.

The Outlook for the Railroads.

It is gratifying to note that as we proceed to press representatives of the leading railroads are in conference with the Interstate Commerce Commission. It is universally admitted by the press and public that the demand of the railroad companies to make a 5 per cent. increase in freight rates is sustained by a strong

prima facie claim on the government's consideration. Substantial increases have been made in wages of certain classes of railroad employees by boards of mediation, and it is idle to imagine that the end of increases in wages is not yet over or ever will be.

Those who are familiar with the various classes of railroad employees know that important sections of skilled and unskilled workmen, who have no well-established organizations to voice their claims, are to-day working at the same wages that they had many years ago. That these men will remain silent is a vain thought. In many instances they are entitled to the most liberal consideration. We refer particularly to the machinists, blacksmiths, carpenters, boilermakers, molders, and others, men of real skill and of whom it may be truly said that their education is never finished, being constantly confronted by new problems, and mastering them with a degree of perfection that is not surpassed by men occupied in any other department of human activity.

Every year, therefore, there will be a new demand for higher wages, and whatever compromise may be reached, the railroad companies are always the losers. But it seems that when the railroads have suggested that an increased maintenance cost should be met by increased freight rates the Interstate Commerce Commission has assumed an attitude of indifference. This is a gross injustice. Many railroads are working hard now to make ends meet, and whatever wrongdoing there may have been in the past in regard to overvaluation and stock watering—these sins of the fathers that are visited upon the children, have to be met manfully.

Those who have taken time to study the subject of transportation are also well aware that in America, the land of high prices, the cost of moving passengers and freight from place to place is cheaper than in any other part of the world, and an increase of even more than 5 per cent. would be so moderate that, like the reduction in the cost of living that we were promised by the adoption of the new tariff law, it would hardly be felt. Then as the government assumes the authority to compel the railroads to enlarge their outlay, the railroads should be permitted to charge more for a better and more costly service.

How Capacity of Locomotive Boilers May Be Forced.

Years ago, when the locomotive that had borne the heat and burden of train hauling from the beginning of railway operating to about 1876 began to fall into disrepute, because with its cylinders 17 x 24 inches, two pairs of 5-feet driving wheels, 17.45 square feet of grate area, and heating surface 1093 square feet, it failed to haul the increasing size of passenger trains on time, the superintendent of motive power of a large leading Eastern railroad intimated that he intended designing an improved heavy passenger engine and asked his intimate friends for suggestions. The writer proposed greater heating surface and grate area in proportion to cylinder capacity, other suggestions were made by experienced designers and an engine was built which proved famous in its day.

The old 17 x 24 inches American locomotives were exceedingly efficient engines in their day and it was common for them to burn 2,000 pounds of coal per hour, which was over 80 pounds per square foot of grate. How much more coal per hour burned when the engines were pushed was never known with certainty.

Modern locomotives are much harder worked than those of long ago; at least the performance is more accurately known. In tests made on the Altoona plant of the Pennsylvania Railroad, to obtain from the modern locomotive the average power required, it was necessary to consume fuel at the rate of about 100 pounds of coal per square foot of grate area per hour, and to obtain the maximum power required it was necessary to burn 150 pounds, and at times an excess of that amount, per square foot of grate per hour. As Mr. Crawford remarks in quoting these figures: "To obtain the power necessary to perform the work demanded, a boiler which from its heating surface would be rated at 320 horsepower, is frequently forced to develop over 1,500 horsepower, and our records show that another boiler, which would on the basis of heating surface be rated at about 400 horsepower, has developed as high as 1994 boiler horsepower."

The performance stated above requires coal consumption at the rate of 6,000 to 10,000 pounds of coal per hour; and in the case cited this was done on a grate of 55 square feet. Such performances cannot be achieved without the aid of a mechanical stoker.

The Adoption of Fuel Oil.

The rapidity with which fuel oil has been displacing coal in many lines of industry has become a point worthy of note the world over. Thirteen years ago oil as a competing fuel with coal was practically unheard of on this continent. The first experiment along the lines on which it has now become so important was the conversion in 1900 by the Southern Pacific Railway of one of their locomotives from the use of coal to oil. That was the beginning. At the present time oil-burning locomotives are operated exclusively upon 20,910 miles of line in the United States, and 587 miles in Canada; and, in conjunction with coal burners, on an additional 4,720 miles in the United States. Some idea of the enormous rapidity of the adoption of oil may be formulated when it is considered that a length of track capable of encircling the globe has been converted from the use of the one fuel to the other in such a short period of time.

More Rolling Stock Wanted.

Those who became alarmed some weeks ago when a Montreal newspaper stated that the car companies would soon be closing down for want of business, will be relieved to learn that the Dominion government is in the market for new equipment for its railways. Both passenger and box cars are required, but the latter especially are in great demand, owing to increased business on government lines. It will surprise these people to learn that the Moncton shops of the I. C. R. are overtaxed, and additions to the plant will shortly be required. The C. P. R. are also greatly increasing their output from the Angus shops, indicating that they are looking forward to bigger traffic records. For the five weeks ending November 5, these shops supplied 233 cars of all kinds, and 7 locomotives.

Longest Railroad Run.

A claim is made by a Baltimore & Ohio special train to a world's record for longest non-stop run, the figures being 130 miles in three hours and 55 minutes, or 48.7 miles per hour. This is nowhere near the daily performance of the 10:30 a. m. train on the Great Western Railway —London to Plymouth—225 miles, in four hours and seven minutes, without stop, or 54.6 miles an hour. The last 30 miles are over a very hilly road. Some years ago the mileage from London to Plymouth (Great Western Railway) was longer by 21 miles, and these 246 miles were covered without stop every day at about the same speed as the present run.

A Good Beginning.

The divinity that doth hedge a king is strong among our news collectors. A press agency has considered the circumstance sufficiently important to wire to all creation the fact that William Averill Harriman, son of the late E. H. Harriman, has entered the Union Pacific Railroad repair shops to learn railroading from that foundation. It is a very sensible move on the young man's part, and promises for him a prosperous business career.

There is some uncertainty among many railroad men as to the most economical length of boiler flue. In tests made by the Pennsylvania Railroad Company they found that short flues show an advantage in activity of combustion and rapidity of evaporation but with lower boiler efficiency.

Mikado Type of Locomotive for the Pere Marquette Railroad

During the past few years it has become the almost universal practice, on American railroads, to use eight-coupled locomotives in through freight traffic. On heavy-grade divisions it is sometimes necessary to employ more powerful units such as ten-coupled or Mallet locomotives; but on low-grade lines having good track conditions, the heaviest tonnage trains are being successfully handled by eight-coupled engines.

The two types of locomotives most generally used in this service are the Consolidation (2-8-0) and the Mikado (2-8-2) With the same weight on driving wheels these two classes, at slow speed, will exert practically the same tractive force. With an increase in speed, however, the superiority of the Mikado type becomes apparent; as owing to its greater steaming capacity, the tractive force falls off less rapidly than in the case of the Consolidation. Hence, at a given speed, a Mikado type locomotive will haul a greater tonnage than a Consolidation; or with the same tonnage, it will make better time. From a constructive standpoint the Mikado type also possesses advantages, because there is room above the trailing truck for a firebox having not only large grate area, but also ample depth and volume. This provides sufficient space between the grate and bottom row of tubes for a brick arch, which is an important aid to combustion when burning bituminous coal. In heavy Consolidation type locomotives with comparatively large driving-wheels, the firebox throat is necessarily so shallow that it is difficult, if not impossible, to apply a satisfactory design of arch.

The Pere Marquette Railroad has recently placed in service ten Baldwin Mikado type locomotives which are excellent representatives of this class of power. These engines are equipped with Schmidt superheaters. In general design they are similar to locomotives which are in successful operation on the Illinois Central and Chicago Great Western roads. The average weight on each pair of driving-wheels of the Pere Marquette locomotives is about 54,500 pounds, and with a tractive force of 53,000 pounds; the ratio of adhesion is 4.10. With reasonably careful handling this tractive force can be developed without slipping the drivers; and the combination of large cylinders, high steaming capacity and comparatively large wheels, gives these engines good speed capacity and provides the means for developing large horsepower.

While the constructive details of these locomotives include no unusual features, there are a number of points that are worthy of attention. The depth of the firebox throat, from the under side of the boiler barrel to the bottom of the mud-ring, is 29 ins., while the distance from the under side of the arch tubes to the same point is 23 ins. This is liberal, especially when it is remembered that in wide firebox superheater locomotives, a thin bright fire should be carried. The furnace equipment includes a steam-jet smoke consumer, with four combustion tubes on each side. These are placed in a line parallel with the surface of the grate, and a short distance above the level of the fire. This device has proved very effective in preventing smoke.

The distribution of the steam is controlled by 15-in. piston valves, set with a lead of 1/4-in. Walschaerts valve motion is used in conjunction with the Ragonnet power reverse gear.

A study of the dimensions of these locomotives shows how well they are adapted either to slow speed drag service, or to fast, heavy freight service. This feature is of special value on a division where various classes of freight are handled, as one type of locomotive can be used in either fast or slow traffic.

The following are the general dimensions:

Gauge, 4 ft. 8½ ins.; cylinders, 27 ins. x 30 ins.; valves, piston, 15 ins. diameter.

Boiler.—Type, straight; diameter, 82 ins.; thickness of sheets, ¾-in.; working pressure, 185 lbs.; fuel, soft coal; Staying, radial.

Fire Box.—Material, steel; length, 120⅝ ins.; width, 84 ins.; depth, front 89¼ ins.; depth, back, 75¾ ins.; thickness of sheets, sides, ⅜-in.; back, ⅜-in.; crown ⅜-in.; tube, ½-in.

Water Space.—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Material, steel; diameter, 5⅜ ins. and 2 ins.; thickness, 5⅜ ins., No. 9 W. G.; 2 ins., No. 11 W. G.; number, 5⅜ ins., 36; 2 ins., 262; length, 20 ft. 6 ins

Heating Surface.—Fire box, 241 sq. ft.; tubes, 3,833 sq. ft.; firebrick tubes, 32 sq ft.; total, 4,106 sq. ft.; grate area, 70 sq ft.

Driving Wheels.—Diameter, outside 63 ins.; center, 56 ins.; journals, main, 11 ins. x 12 ins.; others, 9 ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 33 ins.; journals, 6 ins. x 10 ins.; diameter, back, 42 ins.; journals, 8 ins. x 14 ins.

Wheel Base.—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total engine, 35 ft. 2 ins.; total engine and tender, 65 ft. 1½ ins.

Weight.—On driving wheels, 217,700 lbs.; on truck, front, 25,200 lbs.; on truck back, 39,200 lbs.; total engine, 282,100 lbs.; total engine and tender, about 435,000 lbs.

Tender.—Wheels, number, 8; diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 14 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 880 sq. ft

MIKADO TYPE LOCOMOTIVE FOR THE PERE MARQUETTE RAILROAD.
J. J. Waters, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Air Brake Department

Universal Control Valve.

The large diagrammatic view is of the Westinghouse Common Standard Universal control valve of the U. C. brake equipment, of which photographic views and general arrangement were shown last month.

This operating valve is for the single brake cylinder equipment and is operated either electrically or pneumatically. The names of the parts on the left side or service portion are No. 4, the equalizing piston which moves the graduating valve and equalizing slide valve, the double end piston and attached slide valve below it is the release piston and slide valve.

Directly under this portion is the service reservoir charging valve and to the left of it is the service port check valve (15), and the emergency reservoir check valve is located in the equalizing piston cylinder cover.

In the emergency portion at the right side of the diagram is the safety valve of the E7 type, next to it the cut-off valve and on a horizontal line with it is the high-pressure valve. Just below and under the cap nut with two holes drilled in it is the protection valve and opposite this protection valve is shown the intercepting valve.

In the center of this emergency portion the emergency piston and slide valve are shown, and to the right is the quick-action valve and quick-action piston.

The duties of some of the movable portions are somewhat numerous, but principally the duties of the equalizing piston, slide valve and graduating valve are to control the charging of the auxiliary reservoir, the movements of the release piston and slide valve, and the application of the brake.

The release piston and slide valve (operated by the movement of the equalizing piston and slide valves) controls the opening and closing of the emergency reservoir charging port, the service reservoir charging port, the graduated release port, the emergency valve port, the brake cylinder exhaust port and the auxiliary reservoir vent port.

The service port check valve prevents a back flow of brake cylinder pressure to the service and auxiliary reservoirs during emergency applications, and the service reservoir charging valve separates the service reservoir from the auxiliary and emergency reservoirs when recharging until auxiliary pressure is nearly equal to that in the emergency reservoir. The graduated release piston shown at the end of the equalizing slide valve bushing is a differential valve controlling the graduated release of the brake when the graduated release cap (release piston cylinder cover) is in the desired position.

When this cap is in direct release position, auxiliary reservoir pressure is maintained back of the graduated release piston and the graduated release port to the auxiliary reservoir is closed. When the cap is in graduated position, the graduated release port is opened to the auxiliary reservoir and the graduated release piston cylinder is opened to the emergency reservoir.

The emergency portion controls quick-action and emergency functions, the emergency piston opens and closes the quick-action chamber feed groove and moves the emergency slide valve; this slide valve controls the charging of the quick-action closing chamber, admits pressure from the closing chamber to the quick-action piston, vents air from the back of the high-pressure valve and opens the quick-action chamber to the equalizing portion for purposes hereinafter noted.

At the present time it is not desired to conflict the electric or magnet portion with pneumatic operation, but after pneumatic operation is explained the electric portion will be referred to and its operation explained in detail.

The safety valve limits service brake cylinder pressure to 60 lbs., and is cut off in emergency, which is the duty of the cut-off valve, and the intercepting valve performs a two-phase operation in equalizing brake cylinder and service reservoir pressures, and then cutting off the service reservoir and permitting the emergency reservoir to equalize with the brake cylinder pressure already obtained.

The high-pressure valve admits emergency reservoir pressure to chamber M, operating the cut-off valve and the intercepting valve. The protection valve is to create emergency applications if brake pipe pressure leaks below a predetermined figure and the quick-action portion transmits the serial quick-action by exhausting brake pipe pressure to the atmosphere.

The equipment is charged up by pressure entering the universal valve bracket at the point marked brake pipe, and this passage branches off to the equalizing and emergency portions. The emergency portion is charged by brake pipe pressure, forcing the protection valve from its brake pipe seat to its atmospheric seat; pressure is then free to flow to the emergency piston cylinder, charging the quick-action chamber through a port in the bushing. Quick-action chamber pressure in the slide valve chamber then charges the quick-action closing chamber through the slide valve seat. The tension of the protection valve spring can be varied, but is usually at about 35 lbs.

Brake pipe air also flows to the brake pipe side of the equalizing piston, forcing it and the slide valves to full release position; the release piston and slide valve are held in release position by a spring, but, as the equalizing slide and graduating valves are in release position, the release or right end of the release piston is open to the atmosphere through the equalizing valve exhaust port. The port leading to the application or left end of the release piston is blanked and a friction increasing cavity F in the equalizing slide valve is open to auxiliary reservoir pressure.

In the graduated release position, shown in the cut, brake pipe air can then flow through the feed groove in the equalizing piston bushing to the auxiliary reservoir and through the emergency reservoir check valve to the release slide valve chamber. Auxiliary pressure can also flow into the release slide valve chamber, and is always present under the service reservoir charging valve so that when this valve is lifted from its seat the service reservoir is charged from the release slide valve chamber through ports o, p, q, r, s, t and u. The emergency reservoir is charged directly from the release slide valve chamber through port v. From this chamber air pressure also flows to chamber L back of the graduated release piston.

In this manner all reservoirs and chambers mentioned are charged to the brake pipe pressure desired and the flow of air can be readily traced by following the ports from the markings "auxiliary reservoir," etc. During this charging period the brake cylinder is open to the atmosphere through the cavity K in the release slide valve and past the release magnet valve to the point marked "brake cylinder exhaust." It will be noted that the brake cylinder port extends through the emergency portion to the safety valve.

The chamber M between the high-pressure valve and cut-off valve is open to the atmosphere through the emergency piston exhaust port, and the small chambers back of the high-pressure valve and intercepting valve receive air from the release slide valve chamber through port c^1, and the release slide valve exhaust port is lapped.

There is a small hole through each end of the release piston and both ends of the structure form an air-tight seal against

the cylinder covers when moved to either position, thus, when pressure is exhausted from one end and maintained in the other, the pressure between the pistons moves the structure in the direction of the exhausted pressure. The movement of the equalizing piston and graduating valve alternately opens and closes the ports leading to the ends of the release piston so that the release piston promptly follows the movement of the equalizing piston.

The reservoirs being charged, a reduction in brake pipe pressure permits the auxiliary reservoir pressure in the equalizing slide valve chamber to force the equalizing piston and attached graduating valve toward the equalizing cylinder cover, promptly closing the auxiliary reservoir feed groove and the emergency reservoir charging port. The graduating valve opens a large cavity in the face of the equalizing slide valve (friction increasing cavity) to the atmosphere, which renders the slide valve more difficult to move, so that slight reductions in brake pipe pressure merely result in closing the feed grooves preparatory to an application of the brake.

If, however, the reduction is continued to about 5 lbs., the preponderance of auxiliary pressure overcomes the added resistance of the slide valve and the piston draws it to application position.

In this position of the equalizing parts, the port leading to the release end of the release piston is lapped and the port leading to the application end of the release piston is opened to the atmosphere, hence the release piston and slide valve instantly follow the movement of the equalizing slide valve to application position, thereby closing the brake cylinder exhaust port.

This movement of the release slide valve also closes the service reservoir charging ports, the graduated release port (n) and makes a secondary lap on the emergency reservoir charging port, while the ports b^1 and c^1 make a connection through a cavity in the slide valve, opening the chamber back of the high-pressure valve to the seat of the emergency slide valve. At this same instant the equalizing slide valve and graduating valve open the service port to the brake cylinder and connect the service and auxiliary reservoirs past the end of the slide valve, and pressure from both reservoirs flows through the service port check valve to the brake cylinder, applying the brake. The safety valve through port w^1 limits service brake cylinder pressure to 60 lbs., and as the service rate of reduction cannot exceed the capacity of the emergency piston feed groove to permit a back flow of quick-action chamber pressure into the brake pipe, no action of the emergency portion can be obtained and the connection of ports b^1 and c^1 is merely a preliminary connection for emergency action.

When service and auxiliary reservoir pressures have reduced sufficiently for the emergency reservoir pressure back of the graduated release piston to overcome the lowering pressure and the tension of the graduated release piston spring, this piston will be forced to graduated release position, in which it merely serves for a stop to hold the equalizing piston and slide valve in graduated release position when a graduated release of the brake is desired.

If the brake pipe reduction ceases before the point of equalization of service reservoir, auxiliary reservoir and brake cylinder pressure is reached, the reservoir pressure, due to continued expansion into the brake cylinder, will become lower than brake pipe pressure, whereupon the equalizing piston and graduating valve will be moved to lap position wherein the graduating valve cuts off the flow of air to the brake cylinder and opens the friction increasing cavity to the auxiliary reservoir, thus reducing slide valve friction preparatory to a movement of the slide valve to release position, if release is desired.

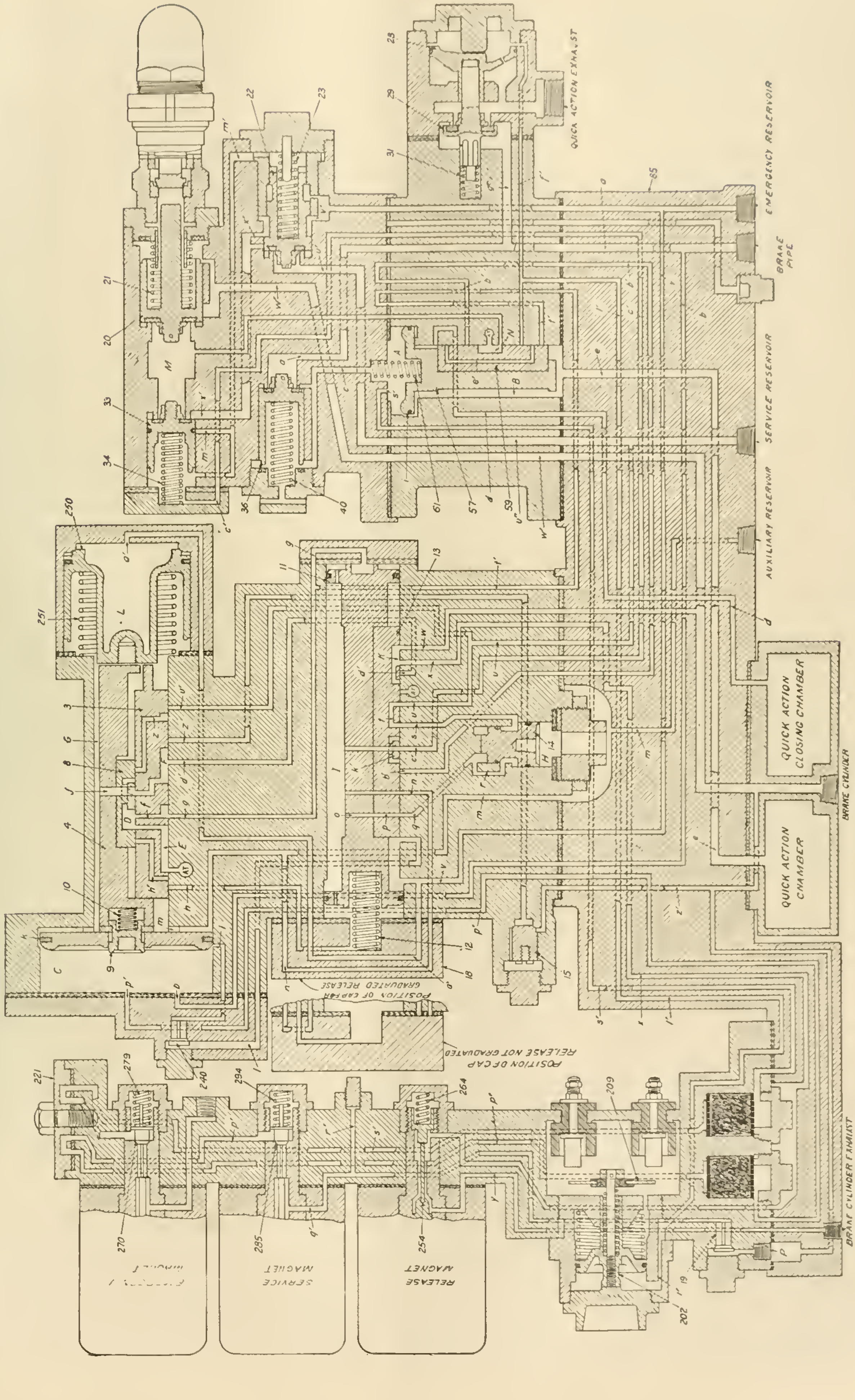
A further reduction of brake pipe pressure again opens the friction cavity to the atmosphere and again opens the service port to admit more pressure to the brake cylinder, which may be continued until equalization of service pressure is reached. Thereafter a service operation can produce no more brake cylinder pressure, but, if the reduction is continued until brake pipe pressure falls to about 35 lbs., the compressed protection valve spring will force the protection valve from its atmospheric seat and cause an emergency application, as will be explained later on.

It will be noted that the difference between lap and service position is, as with the triple valve, a slight movement of the equalizing piston and graduating valve; the slide valve remains in service position and the release slide valve in application position, retaining the brake cylinder pressure.

When a release of the brake is desired, the brake valve handle is placed in the proper position, increasing brake pipe pressure, which forces the equalizing piston and slide valve against the extended graduated release piston, and the release end of the release piston is opened to the atmosphere and the port to the application end is blanked, which causes the release piston to follow to release position and start an exhaust of brake cylinder pressure, and the release slide valve opens the graduated release port, admitting emergency reservoir pressure to the auxiliary reservoir, charging it at the same rate that the brake pipe is being restored, and if brake pipe pressure is maintained, the reduction of emergency reservoir pressure and increase of auxiliary will soon equalize the two pressures when the spring of the graduated release piston returns this piston to its original position and the equalizing piston and slide valve move to full release position. It will be noted, however, that the equalizing parts stop in graduated release position, but the maintenance of brake pipe pressure causes a prompt release of the brake and a complete movement to release, and at the beginning of the movement toward release the release slide valve still in application position holds port d^1 open to the atmosphere which makes a slight but definite drop in auxiliary pressure which is similar to bleeding off a triple valve, as it makes positive the movement from release position, and the release piston will then move and open the emergency reservoir to the auxiliary for recharge.

If, however, a graduated release of brakes is desired, the valve handle is moved to release for a moment (depending upon other conditions), then back to lap position and thereafter alternated between running and lap positions for as many graduations as desired. The first movement of the equalizing piston and graduating valve opens the auxiliary vent port as explained, and the piston and slide valve move to graduated release position, being held by the graduated release piston. The release piston follows to release position and starts an exhaust of brake cylinder pressure and makes the connections noted but, if the brake valve handle is moved to lap position, brake pipe pressure cannot be maintained or increased while the undisturbed emergency reservoir pressure is recharging the auxiliary reservoir, therefore the higher auxiliary pressure moves the equalizing piston against brake pipe pressure to graduated release lap position, wherein the port to the application end of the release piston is opened to the atmosphere and the release piston is reversed to application position, cutting off the escape of brake cylinder pressure and recharge of the auxiliary from the emergency reservoir. Five or six of these graduations can be readily made with a little practice, each one making a further drop in brake cylinder pressure, until it is finally exhausted or until brake pipe pressure is within a few pounds of the maximum carried. It will also be noted that in graduated release position the service reservoir charging valve is closed due to a lower auxiliary pressure under the valve, and the feed groove from the brake pipe to the auxiliary and the port from the brake pipe to the emergency reservoir for charging is also closed.

When these graduations are continued until brake pipe pressure is almost restored or until the emergency reservoir has recharged the auxiliary to within 5 lbs. of that in the emergency reservoir, the service reservoir charging valve will be forced open (provided that a release is desired) and the service reservoir is



TYPE U COMMON STANDARD UNIVERSAL VALVE, DIAGRAMMATIC.

recharged from the release slide valve chamber, making a further reduction in emergency reservoir pressure, which will permit the auxiliary pressure and the graduated release piston spring to return this piston to its normal position, when the equalizing parts will move to release position and recharge all reservoirs from the brake pipe, as already explained.

In this manner brake cylinder pressure can be retained or exhausted, partially or wholly at the will of the operator, the amount released being in proportion to that admitted to the brake pipe, but during the transition period it may be advisable to cut out the graduated release feature until such time as the majority of the cars in a train are equipped with universal or control valves; this is done by turning the release piston cylinder cover (graduated release cap) to direct release position in which the graduated release port is blanked, as shown in the diagrammatic view, and auxiliary pressure is constantly in the chamber back of the graduated release piston.

When brake pipe pressure is then increased for release after an application of the brake, the equalizing parts move to full release position, as the graduated release piston cannot be moved and the emergency reservoir pressure cannot flow back into the auxiliary for graduated release and recharge consequently the release of the brake is straight away as with a triple valve and the auxiliary is recharged from the brake pipe, but the service reservoir charging valve is held closed until after the release is accomplished.

When brake pipe pressure is reduced at a faster rate than quick-action chamber pressure can expand through the emergency piston groove into the brake pipe, an emergency application will occur. This rate of reduction is made possible by the use of the brake valve in direct application or emergency position or the opening of a conductors valve. In this event the differential in pressure between the brake pipe and quick-action chamber forces the emergency piston and slide valve to emergency position in which the slide valve vents the pressure from behind the high pressure valve through a cavity in the release slide valve (the equalizing portion having moved to application position with the brake pipe reduction) and the exhaust cavity of the emergency slide valve. At the same movement the emergency slide valve admits quick action closing chamber pressure to the quick-action piston cylinder, this piston then forces the quick-action valve from its seat and exhausts brake pipe pressure to the atmosphere and the emergency application is thereby serially transmitted to other brakes in the train. This propagation of quick action is in a manner similar to that of the triple valve, save that brake pipe pressure is exhausted to the atmosphere instead of vented into the brake cylinder; therefore, as emergency reservoir pressure is not disturbed during the service application, full emergency braking power is obtainable at any time regardless as to previous reductions.

As the high pressure valve is unseated, emergency reservoir pressure always present under its inner area flows into the chamber M, forces the cut-off valve against its safety valve seat, cutting the safety valve off from the brake cylinder and unseating the piston valve of the safety valve.

This same movement of the high pressure valve opens the back end of the intercepting valve to chamber m (this chamber now being cut off from the emergency slide valve exhaust port and opened to the brake cylinder instead) and service reservoir pressure effective on the opposite end of the intercepting valve unseats it, cutting off emergency reservoir pressure from chamber M and permits service reservoir pressure to equalize with the brake cylinder, this equalization is also effective on the intercepting valve whereupon its spring returns it to its original position, cutting off the service reservoir and allowing emergency reservoir pressure to flow past the high-pressure piston and equalize with the brake cylinder pressure already obtained from the service reservoir.

It will be understood that this entire emergency movement is practically instantaneous, the two-phase operation of the intercepting valve is finished in an instant, hence the first flash of emergency reservoir pressure merely fills the chamber M.

The release after an emergency application is accomplished in the usual manner by increasing or restoring brake pipe pressure.

As soon as quick-action closing chamber pressure has escaped through a drilled hole in the quick-action piston, the quick-action valve spring returns the quick action parts to the position shown in the diagram. The increase in pressure seats the protection valve against its atmospheric seat and then forces the emergency piston and slide valve to release position. Approximately 105 lbs. brake cylinder pressure is thus obtained from 110 lbs. brake pipe pressure, but service reservoir pressure has been separated by the intercepting valve and only service and auxiliary equalization pressures need be exceeded in order to return the equalizing parts to release position. This is usually at from 85 to 88 lbs.

As the release piston is returned to release brake cylinder pressure, pressure again flows from the release slide valve chamber to seat the high pressure valve.

Should the emergency piston fail to return to release position from any cause whatever, the equalizing slide valve moving to release position will open the quick-action chamber maintaining port to the atmosphere, which will then bleed the quick-action chamber for a return of the emergency piston.

With the exhaust of brake cylinder pressure, the closing of the high pressure valve and the opening of chamber M to the atmosphere, the spring 21 will return the cut-off valve to the position shown in the diagram, when the safety valve piston is reseated by the safety valve adjusting spring and the recharge of reservoirs occurs as stated in connection with release and charging positions of the universal valve.

In order that this may be of more practical value to the inspectors and repairmen, we will include the following.

To cut out the brake, close the cut out cock in the brake pipe branch and bleed all reservoirs.

To bleed off the brake, open the bleed cock in the auxiliary reservoir until the brake starts to release.

Do not bleed off the brake with the emergency reservoir drain cock.

Do not expect the universal valve to apply with less than a 5 lb. brake pipe reduction.

Under present conditions, do not expect it to charge and recharge as fast as the smaller equipments.

Expect to get an emergency application if the brake pipe pressure leaks down to 35 lbs.

Do not expect the brake to release promptly with other brakes in long trains after an emergency application, as 65 lbs. in the brake pipe will usually release the triple valve, while 85 or 90 lbs. auxiliary pressure must be exceeded before the universal valve can be released.

If there is a blow or waste of air at the brake cylinder exhaust port when charging up the car, it indicates that someone has bled the brake off with the emergency reservoir drain cock, apply the brake once or twice, and the blow may stop. If it does not, expect to find some dirt under the release slide valve.

As the brake cylinder exhaust port passes practically all the way through both portions of the universal valve as well as past the blank cap substituted for the electric portion, it follows that a leak through any of the gaskets in the equipment could cause the blow, hence the importance of knowing that all bolts and nuts are securely drawn and that the bolts have ample thread.

If all gaskets are drawn tight, the blow may be from the equalizing slide valve as well as from the release slide valve, if the release slide valve leaks it will also show at the release slide valve exhaust port, and similarly the leaky equalizing slide valve will show up at the equalizing valve exhaust port.

Do not confuse a short puff of air with a leaky slide valve; expect a short puff

from the equalizing exhaust port when the brake starts to apply.

Expect short puffs from both equalizing and release slide valve exhaust ports when the brake starts to release, there is a very good reason for this.

A constant leak from the equalizing valve exhaust port when the brake is released may also be from the leather seat at the release end of the release piston, a leak when the brake is applied may be from the slide valve or from the leather seat at the application end of the release piston.

A leak from the release piston exhaust port, only when the brake is applied would indicate a leaky graduating or equalizing slide valve.

A leak from the emergency piston exhaust port indicates a leaky emergency slide valve or an emergency reservoir leak past the seat of the high pressure valve.

A leak from this exhaust port when the brake is in the emergency could be from the emergency slide valve, from the release slide valve or from the back cap gasket of the high pressure valve.

A leak from the quick action exhaust port would be from the rubber seated valve or from the emergency slide valve.

Should a heavy blow from this point occur after an emergency application and continue when a release is attempted, it indicates that the quick action piston has stuck in the bushing or that the quick-action valve spring is too weak.

A blow from the holes in the protection valve cap indicates that the leather atmospheric seat back of the protection valve is at fault.

If the above is noted in connection with a blow at these exhaust ports a little reasoning and observation will make it apparent that a leak from these slide valves will show at more than one place at a time, hence the part at fault is readily found.

Some other tests can be made to locate these disorders, but at the present time it is not desirable to complicate the above.

It must be remembered that emergency reservoir pressure surrounds the release pistons and is always present in the release slide valve bushing.

Auxiliary reservoir pressure is always present in the equalizing slide valve bushing, however, this does not refer to the graduated release feature when operative.

Auxiliary reservoir pressure is always back of the graduated release piston until the universal valve is in graduated release, then emergency reservoir pressure is always present.

The equalizing portion cannot work quick action during a service application, if the brake ever does go into emergency during a service reduction it must be due to some triple valve in the train; however, there is a remote possibility of the feed groove of the emergency piston stopping up, which would likely cause undersired quick action, but this would not be due to any part of the service portion of the universal valve.

Should the brake fail to remain applied after a service reduction, look first for a brake cylinder leak.

Should it release through the universal valve exhaust port, see that brake pipe pressure is not increasing, then look for a leak in the service or auxiliary reservoirs.

In graduated release an auxiliary or service reservoir leak would merely cause occasional exhausts of air from the brake cylinder exhaust port.

If brake pipe pressure is increasing while the application is attempted, and no leakage into the brake pipe from the brake valve, it points to leakage from the emergency reservoir past the emergency reservoir check valve into the brake pipe.

If the brake fails to apply upon a 10 or 15 lb. reduction and instead a heavy blow occurs at the brake cylinder exhaust port, it indicates that the release piston and slide valve have remained in release position, due to excessive friction or a closed port in the release end of the release piston.

Should it require 10 or 12 lbs. reduction to apply the brake, it would point to excessive friction or a stuck packing ring on the equalizing piston.

Should the brake apply in full after a light brake pipe reduction, there being no noticeable drop in brake pipe pressure, it indicates that emergency reservoir pressure is leaking back into the service reservoir, possibly past the seat of the intercepting valve.

If the brake fails to release with ample pressure in the brake pipe, look for a broken brake cylinder release spring or fouled rigging before deciding that the universal valve is at fault.

Should the air pressure fail to exhaust from the cylinder after an application and immediate release, note that the graduated release cap is in direct release position before deciding that the equalizing piston packing ring is stuck or leaking.

Failure to release may also be due to excessive friction of the release piston, a closed port at the release end of the piston or a stopped-up port through the application end of the release piston.

Allow ample time for the large reservoirs to charge before attempting to make a brake test: it usually requires over two minutes with unlimited storage volume and somewhat more if the locomotive is to supply the pressures. To minimize the amount of time consumed in shifting cars do not make emergency applications or open an angle cock quickly enough to cause the brake to go into emergency or quick action.

While this is not intended as a complete treatise on the universal valve, it will be of considerable assistance and tend to help the inspectors to reason out the causes of unusual brake action, and in the following issues the electric operation will be explained and a diagrammatic view of the two-cylinder universal equipment will be shown.

Wireless on the Lackawanna.

Mr. David Sarnoff, chief inspector of the Marconi Wireless Telegraph Company, has been superintending experiments on the Lackawanna Railroad with wireless appliances on moving trains, and on Friday, November 21, a very successful experiment was made on trains running from Binghamton, N. Y., to Scranton, Pa. Mr. L. B. Foley, superintendent of telegraphs on the road, said: "In my opinion, this will revolutionize railroading. We won't do the revolutionizing this week, maybe not this month, but the time is coming, and it is not far distant, when the wireless telegraph on trains will make the safety and convenience of railroad traveling 100 per cent. greater than they are to-day. And as a preventive of accidents I think the wireless will prove of the greatest value.

"In the Hudson tubes and Subway, for example, the train dispatcher sits in his room and by the flashing of lights knows exactly where every train is. If two trains get dangerously close together, he can send a signal that will almost instantly stop one or both of them. I believe that the same thing can be done on railroads with the wireless. The dispatcher can sit in front of a board on which the location of each train on the line will be shown by wireless telegraph. If he sees trains getting too close together for safety he can send a wireless message that will stop one of them anywhere—out in the country miles from a telegraph station.

"To-day we sent and received messages so easily that we are convinced that the only thing required to perfect the service is an adjustment of the instruments until they are in tune. We shall make an experimental trip every other day until this adjustment is satisfactory. Then the wireless service on the Lackawanna Limited will become a regular thing."

The wireless apparatus has been installed in the forward part of the train. The aerial consists of a wire rectangle over each of four cars supported at each car corner by a stanchion two feet high. In the rear end of the second car from the front an operator's room has been built, so that the receiving and sending instruments are under the center of the aerial. The experiments have been much commented upon by the daily press and the expectation in regard to the results are of the most sanguine kind. Its success will mark another important era in the introduction of new railroad appliances.

General Foremen's Department

Announcement Regarding the Convention of 1914.

Mr. Wm. Hall, Secretary of the Railway General Foremen's Association issues the following, and desires us to give the matter full publicity in order that the association's work may show a marked improvement in next year's convention:

The proceedings of the 1913 convention of the International Railway General Foremen's Association has been forwarded to each and every member, active and otherwise, and on page 5 will be found the topics for the 1914 convention, with the names of the chairman having the several papers in charge.

These topics are of deep and vital interest to every railroad man, especially those in the mechanical departments, and the members of the association are requested to study these pap rs, making notes of their conclusions as they are arrived at, then summing up the whole matter, forward to the various chairmen, who will summarize the whole and make one first-class paper; this will eliminate having two or more papers on the one topic or subject which consumes too much valuable time.

It has been suggested, and the suggestion will in all probability be adopted, that in order to save time, none of the papers will be read at the convention, the president will announce the different topics, and declare them open for discussion; for usually the papers are not read as they should be in order that comprehensive view can be taken of them, but are garbled over just as quickly as they can be, and I will defy anyone to enter in an intelligent discussion, after hearing a paper read through in this fashion, therefore the time is wasted and could be used to greater advantage in discussing them.

Advance copies of the various papers will be in the hands of the members at least thirty days prior to the convention, which will give them ample time to read them through several times, and become quite familiar with their contents, and enable them to come to the meetings ready to fortify their own views, or combat those of the other fellow; in the meantime, let each and every member send in to the chairman of the several subjects, just what they think would or would not be good practice.

It was most unfortunate that sufficient time was not given to the discussion of the topic on "Engine House Efficiency," at the last convention, for a most remarkably. good and praiseworthy paper was prepared and presented for consideration on this subject, and it was thought advisable to carry this one topic over to the 1914 convention, with Mr. W. Smith again as chairman; no comment is necessary as to his ability to handle this matter after one has perused the paper he presented at the last session. Another interesting topic is that of "Cylinders, Pistons, Cross-heads, Guides and Valves." The scheme is to bring out the different ideas and methods of maintaining these very valuable adjuncts to the locomotive. Much can be said on this subject, bringing out the best and most efficient, as well as the most economical methods of hanging and supporting guides, what metals are considered the most suitable for cross-heads and slippers, what should be the limit of wear before re-boring or bushing of cylinders, whether steel is preferable to good hammered iron, or vice-versa, for piston rods.

Subject No. 3 should prove to be a very live topic, "The Practice and Methods of Maintenance and Repairs to the Air-Brake and Its Appurtenances." This should be of interest to every one in the mechanical department, as well as the operating department, for if the engineer has a good brake, one that is in the pink of condition, and one that the engineer feels that he can rely upon, he will use it to advantage in getting his train over the road, and in preventing accidents.

Subject No. 4 should be of interest to all concerned, for while there are several methods of welding frames, etc., autogeneous welding is somewhat new and will attract the attention of a great many.

So let me kindly impress upon every member, or others who see fit to send in their views, the necessity of rendering every assistance in their power to make these several papers a grand success; do not leave it till the last minute; remember that procrastination is the thief of time, so do it now, while the matter is fresh in your minds, and thus give the chairmen time to make up their final report, and get them into the hands of the secretary, so that he in turn can have them printed and distributed not less than thirty days prior to the convention.

Macon Apprentice School.

By C. L. Lickert.

The Central of Georgia Railway Company's apprentice school at Macon, Ga., shop was organized August 1, 1912, under the direction of Mr. D. C. Buell, chief of the Educational Bureau of the Union Pacific Railroad Company, Illinois Central Railroad Company, Yazoo and Mississippi Valley Railroad Company and the Central of Georgia Railway Company.

This school as well as several others similarly designed and operated under the same management on the Illinois Central, developed from the fact that there was a shortage in available mechanics competent to take responsible and well paying positions, and the principal object was to train men in accordance with shop ideals and standards so that when vacancies did occur competent men could be taken from the ranks to fill them.

The total enrollment is 75. Several of these included in the total enrollment are messengers used in the shops and several others are rivet heaters in the boiler shop.

One-half hour each day is devoted to class room work, the apprentice being paid for that time and his attendance made compulsory. The subjects, mathematics and reading working drawings are taught on alternate days. The enrollment is divided into nine classes, each class reporting every thirty minutes, from 7 to 9, and from 9:30 to 12.

This half hour period every day is contrary to the period of most apprentice schools, most of them having two-hour periods two or three times a week. It was not adopted, however, for convenience, but for several sane reasons. Consider the fact that nearly all grammar schools have only thirty-minute periods, and the class periods of the Universities are not over one hour. Thirty minutes is about as long as a boy can be kept well interested on one subject. Other advantages of the half hour period are that the instructor can see the boy every day, keeping fresh in his mind the thought of improving every opportunity, and the classes can be made small allowing the instructor to give each boy almost individual attention.

As to the subjects taught, really the first thing necessary for the boy to know, after he learns the use of his machine and tools, is to learn to read

a drawing; therefore, we give him the subject reading working drawings. Mechanical drawing is nothing he can use in the shop and while it teaches him after a while to read a drawing, it is rather a roundabout way to get at it. In teaching reading working drawings, the instructor makes use of a straight-edge, triangle and compasses on the blackboard, showing some of the principles of geometrical construction, also requiring the boys to use these instruments frequently. It is also necessary in teaching reading working drawings to have the student make many sketches on the boards and on paper. After completing this course a thorough study on shop sketching is taken up. When completing these two subjects, without the boy knowing it, he has really learned the biggest part of mechanical drawing, except the use of the instruments and lettering. It has been planned that in the last six months of a boy's apprenticeship, he can, if he wishes, take mechanical drawing and learn the use of the instruments, lettering, etc., so when he finishes his apprenticeship he will not only have a knowledge of reading drawings, but he will know enough of actual drafting, so that at any time he should want to start in drafting he will have the knowledge to enable him to go along and make some progress with it.

It takes a year or a little more to complete the drawing and sketching; after that time, on the drawing day, work is given that might be classed as specific shop instruction; that is, instruction relating directly to the work in the shop. Up to that time, the various crafts which have been mixed in classes are divided and the boy given specific instruction relating to his particular trade.

On mathematics day the beginner in the shop is started at the very beginning of arithmetic with addition, and is so instructed that at the time he has finished the drawing and sketching he will have gone through addition, substraction, multiplication, division, fractions and decimals, which are so essential to a man in the shop.

Applications for employment are rejected unless the boy has gone practically through the grammar school, but even then he is not as thorough as he should be in this part of mathematics, and a review is necessary. Shop arithmetic is carried practically through the four years as far as trigonometry.

In addition to the work already mentioned, from time to time lessons in spelling, composition and penmanship are inserted. Also matters of general information, so that when the boy finishes his apprenticeship he has got something which he can use whether he becomes a mechanic, business man, or anything else, on one hand, and on the other hand, he will get something that will be a definite dividend-bearing asset to the shop. Half the time the generous thing is done by him, and the other half of the time he is specialized for railroad work.

With this apprentice school the instructor has nothing to do with the boy in the shop; therefore, not interfering with that organization at all. In some cases where the apprentice instructor is responsible for the boy in the shop, the men in the shop seem prone to shift the responsibility of the boy and, of course, lose interest in him. It is the desire of the apprentice school to have the whole shop organization work in sympathy with it, and to take a more active interest in the welfare of the apprentice, and to feel that they are responsible for him.

The cost of this apprentice school is made very low on account of the educational bureau having charge. The educational bureau can do all the text book writing and work of that kind without putting on any extra force and without much other additional expense. The cost per apprentice per year is $20.

Reduction of Forces.

By William Hall.

Usually labor is the first to feel any depression in the markets, and if the men employed by the railroads could be brought to see that it would be to their own interest if they would study more the interest of their employers, reduction of forces would not be as great as it is at present. This applies to not only the subordinates, but also to those directly in charge. When one considers the enormous amount of material consigned to the scrap heap, not only of legitimate scrap, but good usable material, and as I myself have seen it, new material, it is not at all surprising that retrenchments are sometimes made.

The working man, and especially the man directly in charge of men, should consider his employer's interest *his* interest, and use every article that is usable, and not consign anything to the scrap bin till it is actually of no value but that of scrap, but men are too prone to say, "The company is rich, they can stand it," whereas if they would try and stop this undue waste of material it would mean the employment of more help, or prevent at least reducing the force in order to overcome this waste.

Again, in order to put a check on the use of new material till second hand or usable material is exhausted, and in order to prevent drawing out of stock more than is absolutely necessary, requisitions should be very closely scrutinized, and wherever possible old material should be required to be returned before issuing new material, care should be taken, however, that the repairing of old material does not cost more than a similar article would cost when new.

Another factor in saving money for the railroads is in the removal of tires from driving wheels, truck and tender wheels (steel tired) before they reach the danger point.

I have taken a great interest in some of these so-called tests of tire turning, and upon looking over the record of the day's performance, I have come to the conclusion that either an enormous amount of material has been wasted, or some one has been grossly negligent in their duty, and not only jeopardizing their position, but jeopardizing the lives of fellow employees, as well as the lives of the patrons of the road.

A few figures as to the cost of tire turning may prove interesting and cause someone to put on their thinking cap. Most all tires are 3½ ins. thick when new, and in the majority of cases but 2 ins. of this is usable, leaving 1½ ins. to be returned at scrap value of ¾-cent per pound. Tires 44 ins. in diameter cost $22.75 each; deducting $1.50 for scrap leaves $21.25 for usable material, or $1.33 for every eighth removed, which on six tires amounts to $7.98.

Tires 52 ins. in diameter cost $31.38 each, allowing $2 for scrap leaves $29.38 for usable material, or $1.83 for every ⅛-inch removed, which on six tires amounts to $10.98.

Tires 56 ins. in diameter cost $36.26 each; allowing $2.26 for scrap leaves $34 for usable material, or $2.12 for every ⅛-inch removed, which on six tires amounts to $12.72.

Seventy-four-inch tires cost $43.48 each; allowing $2.48 for scrap leaves $41 for usable material, or $2.56 per ⅛-inch removed, or $10.24 for four tires.

Trailer tires cost $43.48 per pair; steel-tired truck and tender wheels cost on an average of $44.50 each.

It can be seen at a glance what it means in dollars and cents to allow wheels or tires to run till they reach the danger point, or removing more material than is absolutely necessary, either on account of hard spots or otherwise; deep cuts for hard spots are not necessary if proper tools are employed.

Money can be saved by stopping the leakage caused by indiscriminate use or abuse of tools, saving of red lantern globes, ordinary steam hose, both of which are expensive articles, and other articles of more or less value, and the money thus saved could be used to meet the returns for money invested, instead of reducing the forces to meet this requirement.

New Cars for the Grand Trunk Railway System

The Grand Trunk Railway System have added to their car equipment recently a large number of steel cars of improved designs, comprising several thousand all-steel hopper cars, 2,000 steel frame box cars and 250 steel underframe automobile cars. The hopper cars are specially adapted to the transportation of coal and coke, being self-clearing and having doors which are easily and quickly opened or closed by means of a device which is positive in action as well as safe against accidental discharge of lading. An illustration of the car is shown herewith and they were built by the Pressed Steel Car Company, being designed to carry 100,000 pounds of coal with an addition of the usual 10 per cent. overload. The cars have been giving excellent service. Pressed shapes, plates and structural material have been used to the best advantage to obtain as light a car as possible, consistent with good practice, for the service required.

The center sills, which extend from end sill to end sill, are made of 10-in-20-lb. channels, reinforced at top with cover plates, and at bottom with 3½-in. x 3½-in. angles. The side sills extend from bolster to end and are made of pressed steel, 10 ins. deep; 10-in-15-lb. channels are used for end sills and are attached to side sills by means of gussets and malleable iron push pockets. The body bolster consists of a ¼-in. web plate, reinforced at top with a bent plate, and at bottom with 3½-in x 3-in. angles, and an 18-in. x ⅜-in. tie plate, the center plate and brace being made of malleable iron. The corners of car are further stiffened by means of diagonal braces made of 5-in. x 3-in. angles extending from body bolster at center to end sills at corner of car. The side, end and floor sheets are made of ¼-in. plates reinforced with flanges and angles, the sides being stiffened vertically by seven pressed steel stakes per side, two inside gussets at cross ridge and two channel braces extending across car near the top from side sheet to side sheet.

There are four doors, hung in pairs, each two doors being connected by two 5-in. channels, placed back to back, to which the operating arm of the door gear is connected. The operating device, which is known as the "Lind Gear," consists of levers and cams and is positive in action, and when in the closed position the doors cannot be accidentally opened and lading discharged along the tracks. The trucks are of the arch bar type with rolled channel top arch bar, 5-ft.-6-in. wheelbase, 5½-in. x 10-in. journals; pressed steel truck bolster, and brake beams; malleable iron journal boxes and gray iron wheels being used.

All safety appliances are in accordance with the requirements of the Interstate Commerce Commission and the Canadian Railway Commission, to permit use of cars in service between United States and Canada.

The general dimensions of cars are as follows:

Length inside of body	30 ft. 0 ins.
Width inside of body	9 ft. 6 ins.
Width over side stakes	10 ft. 1½ ins.
Length over send sills	31 ft. 6 ins.
Height from rail to top of body	10 ft. 0 ins.
Height from rail to top of brake mast	10 ft. 9 ins.
Length of drop doors in clear	2 ft. 4¾ ins.
Width of drop doors in clear	3 ft. 4½ ins.
Weight of car body	20,600 lbs.
Weight of two trucks	16,400 lbs.
Light weight of car	37,000 lbs.
Percentage of paying load to total weight of car and lading	75%

The 2,000 steel frame box cars, 60,000 lbs. capacity, were recently completed at the McKees Rocks works of the Pressed Steel Car Company, and are shown by another illustration. These cars have steel under and upperframes and carlines, with wooden floor, roof and sheathing. The center sills are 15-in.-33-lb. channels and the side sills 8-in.-11¼-lb. channels, all extending from end sill to end sill. The end sills are 10-in.-15-lb. channels connected to side sills by means of gusset plates and pressed steel push pockets. The body bolsters are built integral with underframe and are made of four pressed steel diaphragms and one cast center brace each, reinforced at top and bottom with 15-in. x ⅜-in. cover plates. The underframe is further strengthened, transversely, by two cross bearers, made of pressed steel diaphragms, with top and bottom cover plates, 13 ins. deep at center sills and 7 ins. deep at side sills. Also by three shallow diaphragms, made of 5-in. to 6½-in. channels. The side posts and braces are made of 3-in.-6.7-lb. Z bars, and the end posts of 4-in.-8.2-lb. Zs, securely riveted to the side and end sills and plates. The floor boards are made of yellow pine 1¾ in. thick, resting directly on side sills and bolted to intermediate Z bar stringers, being supported at center by yellow pine stringers resting on top of center sills. The side sheathing, or lining, is made of yellow pine 1½ in. thick, bolted

ALL STEEL HOPPER CAR FOR THE GRAND TRUNK RAILWAY SYSTEM.
Built by the Pressed Steel Car and Foundry Company, Chicago, Ill.

to Z bar posts and braces with ½-in. bolts, the end lining being made of 1¾-in. yellow pine, bolted to end and corner posts. There are two center side doors, one on each side of car made of yellow pine.

trucks are of the arch-bar type with 4¼-in. x 8-in. journals and 5 ft. 2 in. base, equipped with pressed steel bolsters, cast steel center plates, M. C. B. brake beams, steel back shoes, malleable iron boxes and 625-lb. gray iron wheels.

Width over eaves	9 ft. 3⅛ ins.
Height from rail to top of floor	4 ft. 2¼ ins.
Height from rail to roof at eaves	12 ft. 7¼ ins.
Height from rail to top of running boards	13 ft. 5 ins.
Height from rail to top of brake mast	13 ft. 11¼ ins.
Weight of car body	23,000 lbs.
Weight of two trucks	12,300 lbs.
Total light weight of car	35,300 lbs.

STEEL FRAME BOX CAR FOR THE GRAND TRUNK RAILWAY SYSTEM.

STEEL UNDERFRAME AUTOMOBILE CAR FOR THE GRAND TRUNK RAILWAY SYSTEM.

Cars are equipped with Westinghouse air brakes, cast steel couplers, vertical twin spring draft gear with key attachment to couplers, roller side bearings, inside metal roof and all safety appliances in accordance with the Interstate Commerce Commission requirements. The

The general dimensions of car are as follows:

Length inside of car	36 ft. 0 ins.
Width inside of car	8 ft. 6½ ins.
Height from floor to carlines	8 ft. 0½ in.
Width of door opening	6 ft. 0 ins.
Height of door opening	7 ft. 7¾ ins.
Length over end sills	37 ft. 4¾ ins.
Width over side sills	8 ft. 9½ ins.

The 60,000 lbs. capacity automobile cars which were built for this company by the Western Steel Car & Foundry at its Hegewisch, Ill., plant, are also illustrated herewith and are of the following dimensions:

Length over striking plate	41 ft. 8 ins.

Length over running boards	42 ft. 0⅛ in.
Length inside	40 ft. 0 in.
Height from floor to carline	8 ft. 6 ins.
Height from top of rail to top of floor	3 ft. 8 ins.
Height from top of rail to eaves	12 ft. 8 9/16 ins.
Height from top of rail to top of running board	13 ft. 6 ins.
Height from top of rail to top of brake mast	14 ft. 0 ins.
Height of side door opening in clear	8 ft. 1¾ ins.
Width of side door opening	9 ft. 0 ins.
Width inside of body	8 ft. 6⅛ ins.
Width over eaves	9 ft. 6 ins.
Width over side sills	9 ft. 0¼ in.
Center to center of truck	30 ft. 6 in.
Height of end door opening in clear	8 ft. 1¾ ins.
Width of end door opening in clear	7 ft. 9¾ ins.

The steel underframe of these cars is principally of the structural type composed of plates and shapes, except for the bolster and cross bearer diaphragms, which are pressed steel. The superstructure is of a wooden type with diagonal tie rods in the side, and each side is fitted with double side doors set off center, and one end is fitted with double-hinged end doors with a vertical operated locking device. The roof is of the inside metal type and the car is braced longitudinally by diagonal braces fitted into the side plates and carlines near the center of the car.

One thousand gondola cars are now being turned out by the Pressed Steel Car Company for the Grand Trunk Railway System, and an additional order for 3,000 box cars is soon to be turned out by the Western Steel Car & Foundry Company.

Pennsylvania Testing Plant.

In a pamphlet prepared by Mr. D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines west of Pittsburgh, he gives the following description of the Locomotive Testing Plant used by the Pennsylvania Railroad at Altoona, Pa., from which an immense amount of useful information concerning the working of locomotives has been obtained.

"To enable the locomotive to work and develop power, at the same time remain in a fixed position, there is provided a sufficient number of supporting wheels to take the place of the track under each driving wheel of the locomotive. The revolution of the supporting wheels is resisted by adjustable brakes upon them, permitting the resistance to be varied so that the work done by the locomotive may be made to conform to the work it will be expected to perform on the road.

"The locomotive is securely connected to a dynamometer which measures the output of the engine and at the same time prevents it from moving forward off the supporting wheels. Apparatus for weighing the fuel and water supplied, and for observing and recording all data necessary for any given test is provided.

"The locomotive remaining in a fixed position permits of careful observation and tests, which would be entirely impracticable with the engine moving under the varying conditions of road service.

"That it is admirably adapted to 'make observations' is evident from the fact that it may be operated continuously for a given time, at a given rate, with one kind of a device or one kind of fuel, and for comparison be operated with another device or fuel at exactly the same rate and time as in the previous tests. With fixed conditions the results obtained with different devices or fuel may be accurately judged and rapidly determined."

The writer enjoyed much experience in making road tests of locomotives, but the greater that experience, the stronger became the impression that the results merely gave a rough approximation of the work done per unit of fuel and of water. A testing plant puts an end to that uncertainty and in our judgment is destined to settle many questions that have never got beyond the realms of fair guessing.

Coke as Fuel.

People who are continually denouncing the smoke nuisance caused by locomotives, frequently raise the question, why can't the railroad companies use coke for fuel where anthracite coal is not available. In ancient times all the railways in Europe burned coke in the fire boxes of their locomotives, and it was abandoned on account of expense. Coke is coal deprived of one-third of its heating properties. Coke is made from a special quality of coal which is not found in all the coal measures. There are now about fifty million tons of coke produced annually, most of it being used in metallurgical operations. There is none to spare for locomotive fuel.

A New Chemical Invention.

While Mr. Henry S. Blackmore, one of the most distinguished chemists of the United States, was in Ottawa, he claimed that he had perfected a process of not only liquefying, but also of solidifying natural gas, and that either the liquid or solid could be used as a motor fuel. The fluid is ethereal in character, like gasoline; and from 8 to 10 gallons are produced from 1,000 cu. ft. of gas. This fluid has the advantage over gasoline both in that it can be produced at a first cost of two cents per gallon, and in that it leaves no carbon deposit to clog the cylinder. In the form of a solid, a cubic foot of the fuel weighs about 5 pounds, and comprises the condensed product of 2,500 cu. ft. of natural gas. It has the appearance of crystallized paraffin, softens to putty-like consistency at 212 degrees, and at 312 degrees turns to gas again. The solid also is superior to gasoline in that a cu. ft. of it will carry an automobile 12 to 15 times as far as a cubic foot of gasoline, and in that the solid as well as the liquid is safe to handle. Interests controlling the inventions of Mr. Backmore have secured large gas fields in the United States and Canada, and will manufacture this motor fuel at 10 cents per gallon or less; and natural gas in blocks will be shipped from the wells to the consumer.

Cementing Boilers.

The "pitting" action of the water on the barrel plates of steel boilers is a common trouble, for although it may vary with the water in certain districts it appears to be of more or less of almost universal occurrence. Numerous compositions have been tried with varying degrees of success. Coating the plates below the water line with a thin layer of cement is now claimed by some engineering authorities to be an excellent and successful precaution. A good brand of Portland cement is used which is ground up with water to the consistency of thick paint and applied with a stiff brush and allowed to "set" as an "egg shell" coating to the barrel without crack or defect. If care is used in the application, the plate being thoroughly cleaned, and all joints and rivet heads coated, it is stated that complete protection can be relied on for a considerable time, no matter what impurities may be in the water, as the cement film remains practically impervious until it becomes broken away.

Rust.

Dry air at the ordinary temperature has remarkably little effect upon steel, as the following illustration shows: Zunstein, in August, 1820, placed a polished iron cross on the summit of Monte Rosa, and, on visiting the spot twelve years later, he found the iron quite free from rust, and with only a slight bronze-colored tarnish upon the surface. At temperatures much above the normal, oxygen, of course, readily attacks iron; but for rusting to occur at the ordinary temperature and at temperatures below and not much above the normal, the presence of water is essential.

President Willard, of the Baltimore & Ohio, in an address before the Merchants' Association of New York, very strongly urged freight rate advance for the railways, as that development was held up by lack of funds. In conclusion he stated: "At the present time railroad development and extension, particularly in the Eastern territory, is practically at a standstill, and personally I am quite unable to see how it can be otherwise until something happens to increase the net earnings of these carriers.

The National Car Equipment Co., Chicago, has been organized by Mr. Chas. B. Moore, Chas. D. Casscadin and M. C. Bevmer; capitalization, $50,000. They will manufacture and deal in railway equipment and supplies.

Consolidation Locomotives for the Wheeling & Lake Erie

Twenty Consolidation locomotives have recently been delivered to the Wheeling and Lake Erie Railroad by the American Locomotive Company.

Having a tractive power of 55,900 lbs., combined with a boiler capable of sustaining this power, these engines become the leaders of their type. They deserve special study, especially just at this time when many roads are adopting the Mikado type. They demonstrate the possibilities of the further development of the Consolidation engine which has recently almost become forgotten. On roads where freight service does not demand a speed greater than that which can be obtained economically by 57-in. wheels, the Consolidation should be the preferable type.

The Lackawanna Mikado was chosen to be used in the following comparison because it is considered one of the best Mikado designs:

	W. & L. E.	D. L. & W.
Road	W. & L. E.	D. L. & W.
Type	280	282
Tractive power	55,900	57,100
Cylinders	26 x 30	28 x 30
Driving wheels	57	63
Boiler pressure	185	180
Weight on drivers	236,000	237,000
Total weight of engine	266,500	312,500

The sustained higher speed demanded of the Mikado required the 63-in. wheel, larger diameter of cylinders and increased boiler capacity. By reducing this speed to within the range of a 57-in. wheel, a saving of 17.4 per cent. in weight was secured with a reduction of only 2.2 per cent. in maximum power.

COMPARISON OF BOILERS.

	W. & L. E.	D. L. & W.
Type	Wagon top	Straight top
Outside diam. of front end	82	86⅛
Outside diam. of back end	89	89⅞
Tubes, number and diam.	293—2	304—2
Flues—number and diam.	43—5⅜	43—5⅜
Tube length	15-6	21-0
Firebox length	114	108
Firebox width	84¼	84¼
Heating surface—		
Tubes and flues	3,293	4,593
Firebox	224	234
Arch tubes	...	27
Total	3,517	4,854
Superheating surface	774	1,085
Grate area	66.8	63.1

Both these boilers were designed by the builder's new standard boiler proportions. They are known as 100 per cent. boilers and were guaranteed to furnish a constant supply of steam for any sustained speed the locomotive cylinders are capable of making. These new proportions represent a radical change in boiler designing. All the variables, such as steam pressure, tube length, tube spacing, grate area, etc., are considered. It is also known that the American Locomotive Company is to publish these ratios in bulletin form in the near future.

The increased heating surface of the Mikado is due mainly to the 5½ ft. additional tube length. The faster speed of the Mikado, with its 63-in. wheels demands this increase. However, the value of this heating surface is not as great as it appears, due to the fact that the evaporative value per foot of length is greater for short tubes than for long tubes.

CONSOLIDATION 2-8-0 TYPE LOCOMOTIVE FOR THE WHEELING & LAKE ERIE RAILROAD.

F. T. Hyndman, Supt. Motive Power. American Locomotive Company, Builders.

A sufficient depth of throat has always been a serious problem with the Consolidation engine. By slightly raising the center of the boiler and taking advantage of the reduced wheel diameter, a firebox depth, from the top of grate to the center of the lowest tube, of 24¾ ins. was secured. The Lackawanna Mikado, having the advantage of a trailing truck, has a similar dimension of 24 ins. The center of the boiler for the Consolidation is 124 ins. above the rail, as against 120 ins. for the Mikado.

Other interesting features included in the Consolidation design are: a superheater, long main driving box, Woodard engine truck, Foulder design of main rod back end, screw reverse gear, and Vanadium cast steel main frames. A firebrick arch was applied to one engine. All engines were arranged so that the Street Stoker and arch tubes could be applied later.

These engines have been put in service in the Toledo division, between Brewster and Huron, a distance of 72 miles. This division is composed of short broken grades. With the exception of a five-mile grade of 1.15 per cent., which requires a helper service, the ruling grade is 0.5 per cent. against eastbound traffic, and 0.4 per cent. against westbound traffic.

All of the engines are not as yet in service, but on the basis of their tonnage ratings, the twenty new engines will supplant twenty-seven former Consolidations having a tractive power of 41,360 lbs.

The new Consolidations are handling 3,130 tons eastbound, and 3,575 tons westbound, at an average speed of 20 miles per hour. Old Consolidations handle 2,310 tons eastbound, and 2,645 tons westbound. Eastbound train loads have thus been increased 35.4 per cent., and westbound train loads, 35.1 per cent.

The average coal burned per trip is 15,360 lbs., average coal per ton mile, .0636 lbs. Average water per trip is 14,416 gallons, average water per ton mile, .0589 gallons.

Mr. F. T. Hyndman, superintendent M. P. & cars, advises that, although the engines have not been in service a sufficient time to prove their merits, from a general observation it appears that the engines are very efficient and economical. They steam very freely and give no trouble whatever from lack of steam when properly fired.

The following are the general dimensions:

Track Gauge.—4 ft. 8½ ins.; fuel, bituminous coal.

Cylinder.—Type, piston; diameter, 26 ins.; stroke, 30 ins.

Tractive Power.—55,900 lbs.

Factor of Adhesion.—4.22.

Wheel Base.—Driving, 17 ft. 0 in.; rigid, 17 ft. 0 in.; total, 27 ft. 0 in.; total engine and tender, 62 ft. 3 ins.

Weight.—In working order, 266,500 lbs.; on divers, 236,000 lbs.; on engine

truck, 30,500 lbs., on engine and tender, 443,800 lbs.

Boiler.—Type, wagon-top, radial stay; O. D. first ring, 83 9/16 ins.; working pressure, 185 lbs.

Firebox.—Type, wide; length, 114 ins.; width, 84¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 5 ins.; back, 5 ins.; depth, top of grate to center of lowest tube, 24¾ ins.

Crown.—Staying, radial.

Tubes.—Material, seamless steel; number, 293; diameter, 2 ins.

Flues.—Material, seamless steel; number, 43; diameter, 5⅜ ins.

Thickness Tubes.—No. 11 B. W. G. flues; No. 9 B. W. G.

Tube.—Length, 15 ft. 6 ins.; spacing, ¾-in. centers.

Heating Surface.—Tubes and flues, 3,293.4 sq. ft.; firebox, 223.7 sq. ft.; total, 3,517.1 sq. ft.

Superheating Surface.—774 sq. ft.

Grate Area.—66.75 sq. ft.

Driving Wheels.—Diameter outside tire, 57 ins.; center diameter, 50 ins.

Driving wheels.—Material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, rolled steel; tender, 33 ins.; kind, rolled steel.

Driving Axles.—Journals, main, 11 ins. x 22 ins.; others, 10½ ins. x 13 ins.; engine truck journals, 6½ ins. x 12 ins.; tender, 6 ins. by 11 ins.

Driving Boxes.—Main, cast steel; others, cast steel.

Driver Brake.—West. American E. T. No. 6, W. N. 3; tender, Westinghouse air signal, F. L. Cyl. to suit, also S. W. B.; pump, 2 11-in. West.; reservoir, 1 28½-in. x 54-in., 2 24½-in. x 60-in.

Engine Truck.—Two-wheel Woodard design.

Exhaust Pipe.—Cast iron; nozzles, 5¾ ins., 5⅞ ins. and 6 ins.

Grate.—Style, rocking.

Piston Rod.—Diameter, 4½ ins.; piston packing, U. S. Gun iron rings.

Smokestack.—Diameter, 18 ins., I. D.; top above rail, 15 ft. 6 ins.

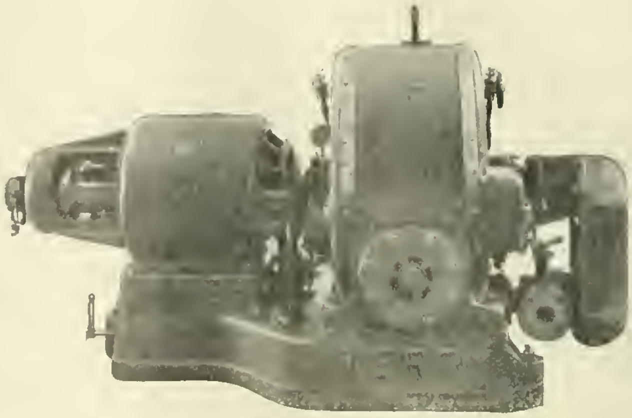
Tender.—Frame, A. L. Company's heavy type; 13 ins. and 10 ins. channels.

Tank.—Style, water bottom; capacity, 9,000 U. S. gallons; fuel, 15 tons.

Valves.—Type, 14-in. piston; travel, 6½ ins.; steam lap, 1 1/16 in.; ex. clearance, line and line; setting, ⅛-in. lead.

A New Train Lighter Set.

For furnishing electric lighting on trains it has become customary to place a lighting set in the front end of the baggage car, where a flexible hose from the locomotive can furnish the required steam. To fill a need in this direction the Terry Steam Turbine Co., Hartford, Conn., has developed and has just put into service a 25 k. w. non-condensing turbo-generator set which has been very successful in this work. The turbine and generator, connected by flexible shaft, are mounted on a common base with all moving parts so guarded that there is little possibility of danger to passersby. The set weighs only 3,400 pounds, and running at 3,000 revolutions per minute gives current at 125 volts.



ELECTRIC TRAIN LIGHTER SET.

Because of the rocking motion of the car, forced feed lubrication is used, thus giving a positive flooding of the journals and maintaining the best efficiency. An emergency governor provides complete control of the speed and voltage. The full power of the machine may be obtained in less than a minute under conditions which would wreck other types of apparatus. It is this capacity for heavy work, and really for abuse, which has earned for this turbine its present reputation for continuous and most effective service.

Picturesque Pennsylvania.

The oldest inclined plane in the world used for the transportation of passengers and freight is the Mount Pisgah gravity railroad near Mauch Chunk, Pa.

This inclined plane which ascends Mounts Pisgah and Jefferson is now a scenic railroad and carries many sight seeing people to the highest altitudes they ever reached, viewing delightfully wild scenery. The Mauch Chunk inclined plane railroad was opened in 1829 and was constructed for the purpose of bringing anthracite coal from the Summit Hill coal mines nine miles southwest of the town of Mauch Chunk, an Indian name meaning Bear Mountain.

Mauch Chunk is the most truly picturesque town in the United States. It lies in a narrow gorge between and amidst high hills, its base resting on the romantic Lehigh river, and its body stretching up the cliffs of the mountains. It lies so compactly among the hills that the houses impinge upon its narrow streets, and stand backed up against the rising ground, with no space for gardens except what the owners can snatch from the hillside above their heads.

Thousands of people make long tours annually to enjoy the fine mountain scenery of Switzerland and Scotland who might witness scenery equally picturesque and alluring in the mountains overlooking Mauch Chunk. Pilgrimages to these regions are becoming more numerous every year, and we believe the district is destined to become the pleasure ground of the Eastern States.

Steel Car Roof Construction.

The circular roof has been extensively introduced on steel passenger cars on account of its lightness and simplicity of construction. It has the objection that deck sash ventilation cannot be employed. The Pullman Company, while using the clear-story roof, have, however, discontinued the use of deck sash ventilation, so that evidently in their opinion this objection is not important. The deck sash is, however, of value in a standing car, and when properly screened is certainly advisable in hot weather, especially when the road is dusty. The Canadian Pacific Railway have compromised on this question and are using a roof of approximately circular form with deck sash. The strength and simplicity of the circular roof are retained with the ventilating qualities of the clearstory type.

One of the most eminent of our latter day scientists was Dr. Alfred Russel Wallace, who shared with Darwin the discovery of the epoch-making theory of natural selection. Dr. Wallace has not been at all complimentary to modern mental development, for he says that there has been no advance either in intellect or morals from the earliest Egyptians to the keel-laying of the latest dreadnought.

In experiments made with engines using saturated steam and others using superheated steam under conditions as nearly uniform as possible, it has been found that an economy of water of about 30 per cent. and coal of 20 to 30 per cent. resulted from using superheated steam at about 200 pounds gauge pressure.

Electrical Department

Electric Locomotive in Freight Service on the Omaha, Lincoln & Beatrice Railroad.

The electric locomotive is extremely useful for handling freight on interurban trolley roads. A great many of these roads find that freight can be handled at a profit. Electric locomotives can be built in all weights, so that the most economical weight can be obtained for the load to be handled and a business built up which would be impossible with the steam locomotive.

An example of the success of the electric locomotive in this service is that in operation on the Omaha, Lincoln & Beatrice Railway, which is only one of many that have been built by the Westinghouse Company. This locomotive, shown in the illustration with seven freight cars, weighs 31.5 tons.

In the winter, when freight business is light, the railway company equips this locomotive with a very large snow plow, by means of which it has been possible to keep open its tracks and maintain schedule.

At present the service performed by this locomotive is to transfer carload and less-than-carload freight over the eight-mile line between Lincoln, Neb., University Place and Bethany. The Omaha, Lincoln & Beatrice Railway Company have been very progressive and have succeeded in persuading several manufacturing concerns to build along its lines. One of the most important of these is the Woods Bros.' Silo & Mfg. Company, for whom they deliver approximately 1,500 cars per year.

ELECTRIC LOCOMOTIVE IN FREIGHT SERVICE ON THE OMAHA, LINCOLN & BEATRICE RAILWAY.

Six More Powerful Electric Locomotives for the New York Central Terminal.

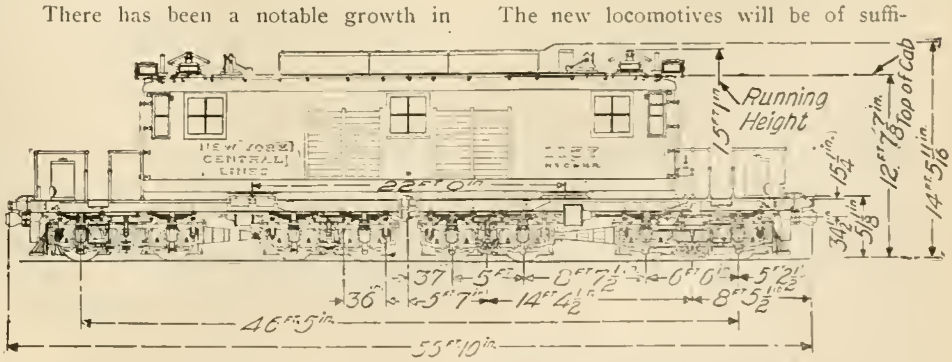
The New York Central & Hudson River R. R. Company has recently ordered six additional powerful passenger electric locomotives from the General Electric Company for terminal service out of New York City. Early in the year ten powerful electric locomotives were ordered from this company for the same service. These engines weigh 100 tons each. While the new machines are of the same type and construction, they are somewhat heavier, weighing 110 tons, and, due to the recent advancement in locomotive design, have materially increased capacity for continuous service.

There has been a notable growth in traffic, requiring larger and heavier train units, since electric locomotives have been in use in the New York Central Terminal. In 1906 thirty-five passenger electric locomotives were built for this electrification. These locomotives of the 4-8-4 type, each equipped with four motors, weigh 115 tons. Twelve more of the same type were placed in service in 1908. All have sufficient tractive effort to handle a 535 gross weight train at 60 miles per hour.

The ten 100-ton electric locomotives ordered the fore part of this year are designated type 4-4-4-4 and are each equipped with eight bipolar, gearless motors, all the weight of the machine being carried on motor-driven axles. These engines are designed for pulling the heavy limited trains. They are capable of operating a 1,000-ton train in emergency service.

But the weight of trains which are being hauled out of the Terminal is increasing steadily, and some of the more important trains now weigh over 1,000 tons.

The new locomotives will be of sufficient capacity to handle these heavier trains. The 10-ton increase in weight in these machines is due to the greater amount of material in the motors, which are of larger capacity.



TYPE OF ELECTRIC LOCOMOTIVES FOR THE NEW YORK CENTRAL.

The previous ten 100-ton locomotives have a capacity for developing 1,460 horsepower continuously, 2,000 horse-

power for one hour and can develop as high as 5,000 horsepower for short periods. This corresponds to a tractive effort of 9,000 pounds at 60 miles per hour continuously, or 13,500 pounds at 54 miles per hour at the one hour rating. The six new electric engines will develop 2,000 horsepower continuously, or 2,600 horsepower for one hour. The equivalent tractive effort is 14,000 pounds at 54 miles per hour continuously, or 20,000 pounds at 49 miles per hour at the one hour rating. They are able to haul 1,100-ton trains in continual service between the terminal and Harmon, are capable of operating 1,200-ton trains in emergency service, and 1,200-ton trains on level tangent track continuously at 60 miles per hour.

In point of design and construction the new machines will be of identically the same type as the former ten engines, having an articulated frame with bogie guiding trucks at each end. The car containing the engineer's compartment and that for the operating mechanism is swung between the two parts of the frame on center pins. Each section is equipped with two-axle trucks having a driving motor mounted on each axle. All the axles are, therefore, driving axles; and the eight motors, of the bipolar, gearless type, are of the same general design as the motors on all the previous 57 locomotives, and are provided with ample forced air ventilation.

The motors are electrically connected permanently in parallel in pairs, and the pairs can be connected in these combinations, viz., series, series-parallel and parallel. They are insulated for 1,200 volts, so that, if at any future time it should be desired to operate the locomotive on this voltage, the pairs of motors could be changed from parallel to series connections and the same speeds and control combinations obtained as on 600 volts.

The new locomotives are now under construction in the works of the General Electric Company at Schenectady, N. Y., and will be placed in operation as soon as completed. Compared with existing types of electric engines, these machines have greater capacity and higher efficiency than any other high speed electric locomotive ever constructed. Withal, the total weight, weight per driving axle and "dead weight" is less than that of any other locomotive approaching their capacity.

Submarine Telegraph Cable.

Recently a telephone submarine cable was laid between Vancouver and Nanaimo on Vancouver Island, British Columbia. This telephone cable which is nearly 2 inches in diameter and 28.3 nautical miles long was made in England. To thoroughly protect this submarine cable from mechanical damages and from sudden changes in temperature while on shipboard it was stored in a large steel tank, Fig. 1, filled with water. The cable was coiled layer upon layer. Observations were taken every day of the temperature of the water in the tank.

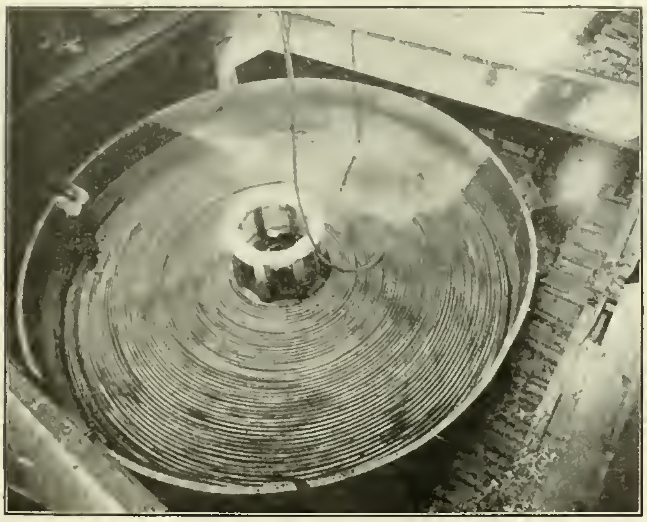


FIG. 1. SUBMARINE TELEPHONE CABLE IN TANK OF WATER.

FIG. 2. COILING OF CABLE IN BARGE PREVIOUS TO LAYING.

Upon arrival at Vancouver, the cable was transferred to a barge and coiled as in Fig. 2 in such a manner so that it would run out freely when laid. During the entire operation of laying, conversations were carried on through this cable to parties in Vancouver and distant cities.

Railroad Coach Lighting.

The Association of Railway Electrical Engineers have had a committee at work for the past summer on illumination for railroad coaches.

Bare lamps which obtrude in the vision of the passengers are low in efficiency. Since they are both uncomfortable and inefficient, it is to be hoped that railway managers will discontinue their existence.

Tests showed that clear prismatic reflectors head the list, with heavy density opal a close second. The highest efficiency was obtained with bowl-shaped reflectors open at the bottom.

The tests show that there is no practical difference in the measured illumination obtained with the center-deck and side-deck systems of lighting. In the center-deck system the lamps are placed in a single line along the center of the car. In the side-deck system one row of lamps is placed over each row of seats. However, the center-deck system has important advantages in lower cost of lamp renewals and cleaning and the use of larger and more efficient lamps. To avoid bad shadow effects, it is found that lamps must be spaced opposite every two pairs of seats with either system where direct lighting is employed. With indirect or semi-indirect lighting, which, of course, is applicable to only the center-deck system, the spacing can be every three seats. It is interesting to note that both these latter systems in the tests gave higher efficiency than did the bare lamp. Thus, the most comfortable system for the eye under these specific conditions consumes less electricity than the most uncomfortable system.

Electrically Operated Cranes.

Two large 150-ton pontoon cranes have recently been built for the United States Navy Department. One will be placed in Boston Harbor and one in Honolulu. Both will be used for transferring freight to lighters and for erecting or removing turrets, guns, boilers and other heavy machinery used on battleships.

The control of these cranes is most remarkable. In test it was found possible to lower a weight within 0.0625 in. of a block without touching it. Further orders are expected.

Items of Personal Interest

Mr. A. E. Hale has been appointed roundhouse foreman of the Southern Pacific at Tucson, Ariz.

Mr. Gilbert Dempster has been appointed master mechanic of the Southern, with office at Columbus, Miss.

Mr. W. L. Essex has been appointed master mechanic of the Arkansas, Louisiana & Gulf, with offices at Monroe, La.

Mr. N. J. Shreve has been appointed master mechanic of the Minneapolis, Dakota & Western, with office at International Falls, Minn.

Mr. G. H. Hoffer has been appointed division car foreman of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Springfield, Ohio.

Mr. H. E. Passmore has resigned as master mechanic of the Toledo & Ohio Central to accept service with the Grip Nut Company at Bucyrus, Ohio.

Mr. George E. Smart has been appointed master car builder of the Intercolonial and the Prince Edward Island railways, with office at Moncton, N. B.

Mr. H. H. Parker, formerly roundhouse foreman of the Seaboard Air Line at Portsmouth, Va., has been promoted to general foreman at the same place.

Mr. George Beland has been appointed master boilermaker of the Frisco shops at Memphis, in place of Mr. J. W. Hoover, retired on the pension list.

Mr. B. E. Greenwood, formerly general foreman of the locomotive department of the Seaboard Air Line, has been promoted to shop superintendent, with office at Portsmouth, Va.

Mr. E. J. Nunan has been appointed foreman of the Norfolk & Western at Shenandoah, Va., and Mr. Walter Budwell succeeds Mr. Nunan as foreman of the same road at East Radford, Va.

Mr. J. F. Enright, superintendent of the motive power and car department of the Denver & Rio Grande, has had his jurisdiction extended over the Western Pacific, with offices at Denver, Col.

Mr. S. J. Knowlton has been appointed assistant supervisor of signals of the Maryland division of the Pennsylvania. He filled the position of signal inspector in the office of the Chief Engineer for some time

Mr. L. E. Rush, formerly foreman of the car shops of the Pennsylvania at State Line, Pa., has been transferred to Mifflin, Pa., and Mr. P. R. Bingman has been appointed to succeed Mr. Rush at State Line.

Mr. George L. Bennett has been appointed foreman of the Erie car shop on the Pennsylvania. Mr. Bennett has been in the employ of this company for thirty-six years, and is one of the best cabinet makers in the service.

Mr. A. B. McDonald, formerly general car foreman of the Intercolonial Railway at Moncton, N. B., has been promoted to the position of superintendent of car shops on the same road, with offices at Moncton.

Mr. Charles Bowersox, formerly general foreman of the Toledo & Ohio Central, at Bucyrus, Ohio, has been appointed master mechanic of the Toledo & Ohio Central and Zanesville & Western, with offices at Bucyrus.

Mr. A. J. Eichenlaub has been appointed general foreman of the Baltimore & Ohio Southwestern, with office at Washington, Ind., and Mr. A. E. McMillan succeeds Mr. Eichenlaub as general foreman at Cincinnati, Ohio.

Mr. N. L. Smitham has been appointed master mechanic of the Missouri, Kansas & Texas, with office at Waco, Tex., and Mr. F. Rutledge has been appointed road foreman of engines on the same road, with office at Greenville, Tex.

Mr. G. M. Stone has been appointed master mechanic of the Oklahoma division of the Rock Island Lines, with office at Chickasha, Okla., and Mr. W. J. O'Neill, formerly master mechanic at Chickasha, has been transferred to Shawnee, Okla.

Mr. H. S. Mored, formerly master mechanic of the Burlington, at Ottumwa, Ia., has been appointed master mechanic on the same road at Aurora, Ill., and Mr. D. R. Sweeney, formerly road foreman of engines, succeeds Mr. Mored at Ottumwa.

Mr. Jacob Schilling has been appointed general foreman of the Wabash at Moulton, Ia., in place of Mr. J. Freeman, who has been transferred to Moberly, Mo., as roundhouse foreman, and Mr. S. Altenbaugh has been appointed erecting foreman at Moberly.

Mr. H. B. Hayes, formerly master mechanic of the Alabama Great Southern, at Birmingham, Ala., has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific at Somerset, Ky., in place of Mr. Joseph Quigley, resigned.

Mr. F. Hodnap has been appointed road foreman of engines of the Baltimore & Ohio at Flora, Ill. Mr. W. F. Ross has been appointed to a similar position on the Wheeling division of the same road, and Mr. John C. Basford to a similar position on the Philadelphia division.

Mr. E. M. Sweetman, formerly master mechanic of the Southern at Birmingham, Ala., has been transferred to a similar position on the same road at Princeton, Ind., and Mr. F. Johnson, formerly master mechanic at Sheffield, Ala., has been transferred to succeed Mr. Sweetman at Birmingham.

Mr. Byron Eldridge has resigned as general foreman of the Santa Fe at Arkansas City, to become assistant mechanical engineer, with office at Topeka, Kan. Mr. Harry Whitman has been appointed division foreman of the same road at Gallup, N. M., and Mr. David Richards has been appointed roundhouse foreman at Gallup, succeeding Mr. Whitman.

Mr. Robert Quayle has been appointed general superintendent of the motive power and car department of the Chicago & Northwestern. Mr. Quayle has been over forty years in the employ of the company and has filled all the positions from apprentice machinist to the highest in the mechanical department. His offices are in Chicago, Ill.

Mr. F. S. Rodger has been appointed assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul, with office at St. Paul, Minn. Mr. Rodger was formerly assistant master mechanic on the same road at Green Bay, Wis., and Mr. H. Hart, formerly road foreman of engines at Milwaukee, Wis., succeeds Mr. Rodger at Green Bay.

Mr. J. W. Gibbs, formerly master mechanic of the Virginia & Southwestern, at Bristol, Tenn., has been appointed master mechanic of the Southern at Sheffield, Ala., and Mr. E. L. Akans, formerly general foreman of the Southern at Asheville, N. C., succeeds Mr. Gibbs as master mechanic of the Virginia & Southwestern at Bristol.

Mr. B. B. Milner, formerly assistant master mechanic of the Philadelphia, Baltimore & Washington, with offices at Wilmington, Del., has been appointed special engineer with the York Central Lines, with headquarters at Grand Central Terminal, New York City, and Mr. E. W. Smith has been appointed master mechanic at Wilmington, succeeding Mr. Milner.

Mr. F. E. Patten, formerly master mechanic of the Southern Railway in Mississippi, has been promoted to the position of superintendent, with offices at Columbus, Miss., and Mr. G. N. Howson, formerly master mechanic of the Southern at Princeton, Ind., has been promoted to the position of superintendent of the St. Louis and Louisville division, with offices at Louisville, Ky.

Mr. H. F. Bentley, formerly assistant superintendent of motive power of the Chicago & North Western, has been appointed superintendent of motive power, with office at Chicago, Ill. Mr. Bentley served his apprenticeship as a machinist with the London & Northwestern Railway of England. Twenty-five years ago he entered the service of the Chicago & North Western as a machinist, and was rapidly promoted, holding many positions with the same company. His offices are at Chicago.

Mr. J. P. McAnany has been appointed master mechanic of the Saskatchewan division of the Canadian Pacific, with office at Moose Jaw., Sask. Other appointments announced on the same road are: Mr. F. G. Whiteley, master mechanic of the Alberta division at Calgary, Alta.; Mr. G. Glassford, promoted from road foreman to district master mechanic, also at Calgary, Alta.; Mr. G. Mock, master mechanic of the British Columbia division at Revelstoke, B. C., and Mr. W. H. Evans, master mechanic of the British Columbia division, at Vancouver, B. C.

Mr. H. Honaker, formerly master mechanic of the St. Louis & San Francisco at Fort Scott, Kan., has been transferred to a similar position on the same road at Birmingham, Ala., and Mr. F. A. McArthur, master mechanic on the same road, has been transferred from Springfield, Mo., to Enid, Okla.; and Mr. A. S. Abbott succeeds Mr. McArthur as master mechanic at Springfield. Mr. John Foster has also been appointed master mechanic on the same road at Kansas City, Mo., and Mr. G. R. Wilcox succeeds Mr. E. E. Skipton as roundhouse foreman at Birmingham, Ala.

Obituary.

EDWIN S. WOODS.

Much regret is expressed at the death of Mr. Edwin S. Woods at the comparatively early age of 42. Mr. Woods was president of the railway supply firm of Edwin S. Woods & Co., Chicago, which he organized in 1903. He was the son of Major John L. Woods, of the Buckeye Steel Castings Company. Much sympathy has been expressed to Major Woods in his sad bereavement. We understand that the business of the firm of which the younger Mr. Woods was the head, will be continued as formerly.

EDWIN S. WOODS.

Autobiography and Obituary of Jacob Johann.

Jacob Johann, born November 15, 1830, in Rheinzabren, Rheinphalz, Bavaria, Germany. Parents, George Mathew Johann and Mary Ann Weigle, emigrated to America in 1839, located in Philadelphia, Pa., the same year, where I was raised and schooled.

May, 1847, entered as apprentice the Norris Locomotive Works, served four years and six months, when I was released from my indentures on November 1, 1851. At this time received an engagement to go to Nashville, Tenn., as foreman of a locomotive works, starting to build locomotives for the Nashville and Chattanooga Railroad, then under construction. Resigned this position August, 1852. Returned to my home, Philadelphia. November of this year I engaged to go to St. Louis, Mo., as foreman of the Palm and Robertson Locomotive Works, then starting to build locomotives for the railroads then constructing in Missouri and Illinois.

October, 1853, I returned to Philadelphia to visit my parents and to marry. November 14, 1853, I was united in marriage to Elizabeth Manypenny. November 15, 1853, we departed for St. Louis, Mo., our future home.

In 1855 I resigned my position with Palm and Robertson, purchased an interest in a machine and foundry business which, as superintendent, I conducted until 1859, when the partnership was dissolved and I retired to take service with the Missouri Pacific Railroad as assistant to the master mechanic, Mr. Charles Williams. March, 1865, I succeeded Mr. Williams as master mechanic, served in the capacity until 1872, when I resigned to accept the general master mechanicship of the Chicago and Canada Southern Railway, then under construction. Resigned this position April, 1874, to accept a like position with the Toledo, Wabash & Western Railroad, with office in Springfield, Ill. Assumed this charge June 1, 1874. In 1879 the Toledo, Wabash & Western and the St. Louis, Kansas City & Northern Railroads consolidated as the Wabash, St. Louis & Pacific Ry. I was appointed as general master mechanic for the system. In 1884 the road was reorganized as the Wabash Ry., and I was reappointed superintendent of motive power and machinery. June, 1885, I resigned and severed my connection with this road.

November, 1885, I accepted the position of general master mechanic of the Chicago & Atlantic Railroad. This position I resigned November, 1887, to accept the position of superintendent of motive power and machinery for the Texas & Pacific Railroad. May 1, 1889, I resigned and severed my connection with this road to accept the general western agency for the Safety Car Heating and Lighting Company of New York, with office in Chicago, a new enterprise to introduce steam heating and gas lighting (the Pintsch system) for passenger car service.

November, 1892, I resigned this position to accept service with the Chicago & Alton Railroad as superintendent of motive power and machinery, remaining in this position up to February, 1897. Having been in active railroad service fifty years, I retired to private life and to look after my personal interests, making my home since August, 1874, in Springfield, Ill.

JACOB JOHANN,

January, 1903.

In connection with the above autobiography Mr. H. A. Johann wrote to Dr. Angus Sinclair:

"I enclose you a record of my father's life, which he prepared some years ago, and left with me with instructions to send to you after his death.

"He died November 3, 1913, at his home in Springfield, Ill. His wife died March 6, 1900, and they are buried together in Bellefontaine Cemetery, St. Louis. He is survived by four children."

Mr. Johann was the only surviving charter member of the American Railway Master Mechanics' Association. He was a very active member for many years and was acting president for one year.

RAILROAD NOTES.

The Northern Pacific is in the market for 250 ore cars.

The Chesapeake & Ohio is in the market for 2,000 coal cars.

The Norfolk & Western is to build 1,000 cars in its own shops.

The Great Northern, it is said, is in the market for 40 locomotives.

The Peabody Coal Co. has ordered 350 hopper cars from the Haskell & Parker Co.

The Chicago & Western Indiana has ordered 4 locomotives from the Lima Locomotive Co.

The Chicago, Burlington & Quincy has ordered 500 cars from the Haskell & Parker Co.

The Wheeling & Lake Erie has issued an inquiry for 1,000 hopper cars and 500 gondolas.

The Buffalo, Rochester & Pittsburgh is in the market for 40 to 50 locomotives of the Pacific type.

The Atchison, Topeka & Santa Fe has ordered 140 passenger train cars from the Pullman Company.

The Pacific Great Eastern, Vancouver, B. C., is said to be in the market for a number of locomotives.

The Pennsylvania Southern has ordered a consolidation locomotive from the Baldwin Locomotive Works.

The Central of New Jersey has placed an order for five locomotives with the Baldwin Locomotive Works.

The Oregon Short Line has ordered steel for a number of 100-ft. turntables from the American Bridge Co.

The New England Gas & Coke Co., Boston, Mass., is said to be making inquiries for about 200 coal cars.

The Louisville & Nashville, it is said, will build 4 Pacific locomotives and 16 Mikados at the company's shops.

The Chicago, Burlington & Quincy will install block signals between Denver and Akron, Colo., at a cost of about $200,000.

The Mobile & Ohio has ordered 7 Mikado locomotives and 7 consolidation locomotives from the Baldwin Locomotive Works.

It is reported that the Chicago, Burlington & Quincy is planning the erection of new shops at Aurora, Ill., to cost $400,000.

The Mobile & Ohio has ordered 7 Mikado locomotives and 7 Consolidation locomotives from the Baldwin Locomotive Works.

The Atchison, Topeka & Santa Fe will soon be in the market for 50 locomotives of various types which have not yet been determined.

The Lehigh Valley has ordered 75 coaches from the Pullman Company and 25 baggage cars from the Standard Steel Car Company.

The Pere Marquette has awarded 1,200 freight cars to the American Car & Foundry Co. and has placed 1,200 cars with other interests.

The Oconto Co., Oconto, Wis., it is said, has ordered a six-coupled double-ender locomotive from the Baldwin Locomotive Works.

The New York, Chicago & St. Louis is expected to place orders soon for equipment for its new shops now building at South Chicago, Ill.

The Wabash has ordered 500 gondola car bodies from the American Car & Foundry Co., and is now in the market for 1,000 box cars.

The Minneapolis, St. Paul & Sault Ste. Marie is reported to have ordered 500 box cars and 500 coal cars from the American Car & Foundry Co.

It has been announced by the Chicago, Rock Island & Pacific that work will be started in the spring of 1914 on the new shops and yards at East Des Moines, Ia.

The Lehigh & New England R. R. and the Lehigh Coal & Navigation Co. are reported in the market for 5 consolidation locomotives and 3 switching locomotives.

The Lehigh & New England has ordered 6 consolidation locomotives, 3 switching locomotives, and one other locomotive from the Baldwin Locomotive Works.

The Chicago & Northwestern, which purchased 30 locomotives last month from the American Locomotive Co., has ordered about the same number from the Baldwin works.

The Lehigh & New England Railroad and the Lehigh Coal & Navigation Co. are said to be in the market for 5 consolidation locomotives and 3 switching locomotives.

Approximately $2,000,000 will be spent for the remodeling of the Denver union station, and it will practically create a new station. The work is being done by the Union Depot Terminal Co.

The Louisville & Nashville is planning to build 1,125 freight cars in the company's shops early in 1914. The order will include 600 box cars, 200 ventilated box cars, 100 refrigerator cars, 200 flat cars, and 25 caboose cars.

The Chicago, St. Paul, Minneapolis & Omaha has ordered 1 combination coach and smoking car, 11 coaches, and 2 cafe cars from the Pullman company, and 5 smoking cars and 6 baggage cars from the American Car & Foundry Co.

The Chicago & North Western has ordered 9 dining cars, 36 coaches, 4 vestibule parlor cars, 5 observation cars, and 6 chair cars from the Pullman Company, and 27 smoking cars, 30 baggage bars, and 8 mail cars from the American Car & Foundry Co.

The California railroad commission has ordered the Pacific Electric to submit diagrams and plans of an automatic block and staff signal system for the entire Pacific Electric system outside of Los Angeles, Cal. These must be submitted to the commission by January 1, 1914.

Discovery of Vanadium.

In the course of a paper read by Mr. George L. Morris at the New York Railroad Club on Vanadium Steel in Locomotive Construction, the following interesting historical notes were given:

The metallic chemical element vanadium was first discovered over 100 years ago in some of the lead ores in Mexico. The discovery was discredited at the time. Nearly thirty years later it was re-discovered by a Swedish chemist, Sefstrom, in some remarkably soft and ductile iron made from Swedish iron ore. He gave it its name vanadium in honor of the principal goddess of Swedish mythology, Vanadis, the earth mother. It was soon found to be widely distributed, being present in many rocks and minerals, but always in such small amounts that it was classed as one of the rarest of the elements. It had no industrial application until about 1870, when it began to be used in the manufacture of aniline black and indelible ink. These were its principal uses until about 1900, the main source of supply being some of the Spanish lead mines.

Nothing was done towards using vanadium in steel until 1896, when a few test armor plates were made in France. The tests on these plates showed very superior results, but there was no adequate supply of vanadium in sight to make its use in steel manufacture commercially possible.

Practically nothing more was done towards using vanadium in steel until 1900, when Prof. Arnold, of Sheffield, one of the leading English metallurgists, made some investigations of the effect of vanadium on steel, for a concern which had started to make vanadium alloys. The tests were made with simple carbon tool steels, and the addition of vanadium was found to raise the elastic limit 50 to 100 per cent. without materially affecting the ductility of the steel. Drills made from some of this steel containing only 3/10 per cent. of vanadium proved to be 75 per cent. better than 3 per cent. tungsten tool steel.

Prof. Arnold's report states: "The results of this preliminary investigation have profoundly impressed upon my mind the future before vanadium as a steel-making element."

Further tests and investigations were made by Prof. Arnold with small percentages of vanadium in conjunction with other alloys, tungsten, nickel and chromium. In each case an increase in elastic limit was obtained, generally with an increase also in ductility. The chrome steel with vanadium especially showed remarkable dynamic strength and toughness.

According to Prof. Arnold, vanadium is undoubtedly the element which, together with carbon, acts with the greatest intensity in the way of improving alloys of iron, that is to say, in small percentages. It is undoubtedly the most powerful metal yet discovered for alloying with steels. It forms a double carbide of iron and vanadium and seems to have not only a chemical but a physical influence in promoting the even distribution of the carbon, and retarding segregation. In this manner it renders steel particularly susceptible to improvements due to heat-treatment, and in addition is a powerful factor in the production of steels that are very resistant to wear and fatigue. This opinion of Prof. Arnold's has been amply confirmed during the ten years since it was rendered.

Meanwhile other investigators were busy and by 1905 about 800 tons of vanadium steels a year were being produced, principaly high speed tool steels and chrome-vanadium steel for automobile parts.

In this year an immense deposit of a vanadium ore of a richness and character hitherto unknown, was discovered in Peru, and from a semi-rare metal, vanadium became available as a steel making metal in unlimited quantities.

While the principal application of vanadium cast steel has been for locomotive frames, it is being used to advantage for other castings, as in addition to its high elastic limit and dynamic strength, it has a much higher wear-resisting quality than ordinary cast steel.

Books, Bulletins, Catalogues, Etc.

Proceedings of the International Railway General Foremen's Association.

The report of the proceedings of the ninth annual convention of the above association, held in Chicago, Ill., in July of the present year has just been issued in a handsome volume of 175 pages, bound in flexible leather. The work has been carefully compiled and published by Mr. William Hall, the secretary of the association, and is in every way the best publication that has yet appeared under the auspices of the association. In the August issue of Railway and Locomotive Engineering we took the opportunity to present condensed reports of the various papers presented before the association. The papers, now presented in full, are all of real value and greatly enhanced by the interesting discussions that their presentation called forth, while the numerous illustrations add particular value to the publication. That the association is growing in importance year by year is well known among railroad men, and that it has taken its place among the leading associations of its kind is beyond controversy.

It would be invidious at this time to make distinctions as between the merits and importance of the various papers discussed, but the paper presented by Mr. P. C. Linck, general foreman of the Chicago & Eastern Illinois Railroad, may be fairly looked upon as the most advanced presentation of practical experiences in the application and service of superheating to locomotive service. The discussion which the presentation of the paper drew forth is also of great value, coming as it did from men who are day by day in active contact with the details of the superheater. Portraits of the officers also illustrate the volume.

Proceedings of the Traveling Engineers' Association.

The proceedings of the twenty-first annual convention of the Traveling Engineers' Association, held at Chicago, Ill., August 12-15 of the present year, have just been published in a handsome volume of 375 pages, bound in flexible leather. The book is edited by Mr. W. O. Thompson, secretary of the association, and it embraces the various papers read before the association wi h a full report of the discussions. The subjects included are: "Uniform Instruction to Enginemen on the Handling of Superheat Locomotives," "Credit Due Operating Department for Power Utilization and Train Movement That Reduces the Consumption of Fuel Per Ton Mile." "The Care of the Locomotive Brake Equipment on Line of Road and at Terminals; Also Methods of Locating and Reporting Defects," "Advantages Obtained With the Brick Arch in Locomotive Service," "What Can We Do to Eliminate the Black Smoke Evil on Locomotives?" "Scientific Train Loading—Tonnage Rating; the Best Method to Obtain Maximum Tonnage Haul for the Engine Over the Entire Division, Taking Into Consideration the Grades at Different Points on the Division."

The titles of the various papers give an idea of the importance of the convention. The subjects are treated ably and eloquently, and the discussions are full of interest.

Proceedings of the Western Railway Club.

The official proceedings of the Western Railway Club for the club year 1912-1913, are just issued from the press of the W. F. Hall Printing Company, Chicago, Ill., and form a bulky volume of 434 pages. The club year begins in September so that the volume contains a report of the transactions of the club from September, 1912, to August, 1913. The subjects are invariably among the most important in railroad work. The attendance is always large, and the discussions brought out reflect the opinions of railway men who are not only of wide experience in their calling, but are also capable of giving expression to their thoughts in clear and expressive terms, and the publication in collected form of the papers and discussion present in concrete form the best proof of the utility and service of such associations. The illustrations in the work, which are numerous, add much to the value of the publication.

Beginning Electricity.

Harper's Beginning Electricity, by Don Cameron Shafer, is issued in a new edition of 275 pages with numerous illustrations, and sold at $1. For a beginner it is the book he needs. It explains electricity very simply in connection with experiments which any boy can do, and devices which are easily made. It will be admitted that the best way to learn about electricity is to do something with it in addition to reading about it. A new world is opened up to the beginner. Electricity is one of the most absorbing of all studies. It stimulates imagination, exercises all the faculties and develops the mind. It should be added that while this book is primarily intended for beginners there are many who think themselves advanced that could profit by a perusal of its pages. Harper & Brothers, publishers, New York.

Wireless Book.

Harper's Wireless Book, how to use wireless electricity in telegraphing, telephoning and the transmission of power, by A. Hyatt Verrill, 185 pages, bound in ornamental cloth and profusely illustrated, unravels in an engaging way the mystery of wireless messages. And strange as it may seem, the mysteries are elementally simple when once explained by a writer like Mr. Verrill, and yet wireless may truly be said to be in its infancy, and there is a measureless field for experiment and invention in wireless transmission. In the unexplored realm f wireless telephony there are undiscovered regions, and these are hinted at in the book, and the reader, especially the young reader with the lamp of hope kindled in his mind, may have his eyes opened to the possibilities of wireless telephony. It is pleasing to note that the book is written in a plain commonsense way. The unintelligible jargon of what some call the higher mathematics is avoided. The book is published and sold by Harper Brothers, New York, at $1.

Foundry Machinery.

Foundry Machinery, an elegant volume of 140 pages, by E. Freiber, translated and revised from the German by Charles Salter, and containing fifty-one illustrations, has been issued by Scott, Greenwood & Son, London, England, and is on sale by D. Van Nostrand Company, New York. The work is very comprehensive in its scope and describes and illustrates all the machines and mechanical appliances employed in the foundry to supplement or replace hand labor. There are also described a number of machines and appliances, which, though not exclusively used in foundry work, have, nevertheless, been more or less specially modified for this purpose. They include more particularly hoisting and conveying appliances. The reader readily learns from this valuable book that the foundry industry has made great strides under the pressure of competition, until now many firms are engaged in manufacturing highly developed and technically perfect machines for foundry use. The price of the book is $1.25.

A Pennsylvania Placard.

"Why Railroads Ask Five Per Cent. Increase in Freight Rates," is the heading of a large-sized placard posted conspicuously along the Pennsylvania Railroad. Like "Royal Baking Powder" on the stairs of the Elevated railroad, you cannot get your eyes away from it. We presume the purpose is to keep the patrons of the road informed as to facts and problems of importance. It is a slow method, however, of reaching the Federal Commission through the travelling public. The attack should be more direct. The public travellers have troubles enough of their own without listening to the call of the railroad stockholder. The power to raise rates is a delegated power which never was in the hands of the people and never likely will be. It is a job for experts only, and the proper channels for reaching them is open to the railroads, but large bodies move slowly, but we are much pleased at learning that a conference of Interstate Commissioners and railroad officials is being held, when we are sure the rates will be raised.

News Letter.

The Baltimore & Ohio Railroad Company has issued an interesting document in regard to trespassers, and has outlined a policy in dealing with the subject that is well worthy of the attention of railroad officials. All of the workmen are to become authorized to accost trespassers and point out to them the danger of their ways. The workman will be filled with statistics and pour them into the ears of the startled trespassers. Then there is a police department instructed to make arrests. The idea is a good one, but why not arm all of the employees with the power of making arrests? Moral suasion does not go very far with a hobo. Special laws should be enacted in regard to trespassers on railways. They should be fined or confined. At any rate, the Baltimore & Ohio is taking a step in the right direction, and a considerable reduction in the appalling death list on railroads may be expected.

Read Our Advertisements.

A man seeking for new points about machinery can hardly do better than to read the advertisements of mechanical papers. This class of advertising is always up to date, fresh and complete, shows every improvement and presents every argument showing the superiority of this or that class of machines or tools. There is a fund of information that can be gleaned from advertisements that can be obtained in no other way.

To too many readers the advertisements are announcements to be glanced over without care or attention. People who follow that practice lose many hints calculated to help them in their business. Try reading the advertisements and let us know about your experience.

As a holiday gift book from one railroad man to another there is nothing that could be more highly appreciated than "The Development of the Locomotive Engine," by Angus Sinclair, 114 Liberty street, New York. Price $5.